Methods for Assessing Status and Trends in Pacific Salmon Conservation Units and their Freshwater Habitats

Citation

Pacific Salmon Foundation. 2022. *Methods for Assessing Status and Trends in Pacific Salmon Conservation Units and their Freshwater Habitats*. The Pacific Salmon Foundation, Vancouver BC, Canada. Version 11.

*This report is a living document. It will be updated as we add new Regions to the Pacific Salmon Explorer, as updated data become available, as our data sources, methods, and approaches incrementally evolve, and as we receive feedback on this report. We will update the version number with each new version of the report. To access old versions of the report, please contact **info@salmonwatersheds.ca***

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Cover photograph is by Conor McCracken (CDM Images).

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Acknowledgements

Thank you to everyone who has supported and been a part of this collaborative effort to gather, synthesize, and improve access to data on salmon and their freshwater habitats in British Columbia. In particular, we thank the members of the Advisory and Technical Committees who helped guide this work, ground the assessments in local knowledge, and ensure that the products of this work are relevant and useful for decision making across scales. These Technical committees have included First Nations groups and individual Nations across all seven Regions currently within the Pacific Salmon Explorer, as well as local and regional Fisheries and Oceans Canada staff, staff from the Province of BC, and other salmon experts. Our Population Science Advisory Committee has helped us adapt and hone our methods as we have expanded our work in both scope and geography. Our sincere thanks for your interest, support, and trust in us and in this work, and for sharing your time and expertise with us. We would also like to thank Periscopic Inc. for their technological proficiency in building the Pacific Salmon Explorer tool with us.

We also thank our funders for supporting this work to date. Thank you to the Gordon and Betty Moore Foundation, the Government of Canada through Fisheries and Oceans Canada's Coastal Restoration Fund, the Pacific Salmon Endowment Fund Society, the Government of British Columbia, Environment and Climate Change Canada's Habitat Stewardship Fund, and the Willow Grove Foundation.

This report was produced by the Pacific Salmon Foundation's Salmon Watersheds Program. Thank you to all program staff who have been involved in the body of work described in this report, including Katrina Connors, Eric Hertz, Leah Honka, Eileen Jones, Katy Kellock, Christine Stevenson, Charlotte Whitney, and Vesta Mathers.

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1.0 Executive Summary

Throughout British Columbia (BC), Canada, Pacific salmon play a vital part in the province's culture, ecology, and economy. They provide food, social, and economic benefits to coastal communities and support significant commercial and recreational fisheries throughout the region. Canada's wild Pacific salmon populations are comprised of 430 ecologically, geographically, and genetically distinct groups– defined as Conservation Units (CUs) under Canada's Wild Salmon Policy – which represent unique spawning populations that occur throughout BC and the Yukon. This abundance of CUs represents an important piece of all salmon biodiversity within Canada. While some salmon populations in BC and the Yukon are doing well, others are degraded, declining, or of conservation concern. However, for many populations, we know very little about their current status or the state of their essential freshwater habitats.

The ability to maintain salmon biodiversity depends, in part, on the ability to detect changes in salmon production over time. This type of information helps to diagnose the drivers of salmon population dynamics and identify when and where conservation and management measures are needed to reverse declines. In BC, however, our current ability to make salmon-focused and evidence-based decisions is hindered by the lack of timely and broadly available information on the status of salmon CUs.

To strengthen the baseline of information for salmon in BC, the Pacific Salmon Foundation (PSF) works with First Nations, Federal, Provincial, and Regional Governments, and local independent salmon experts and knowledge holders to evaluate the status of salmon populations. We work with these groups via regional technical committees and Science Advisory Committees to compile the best available data for describing the characteristics, dynamics, and status of salmon CUs and their freshwater habitats throughout BC. Using this information, we evaluate both 'biological status' (the degree of conservation concern) and 'habitat status' (the risk of degradation posed by multiple human and environmental pressures) for each salmon CU. These biological and habitat status assessments form the core of the Pacific Salmon Explorer (www.salmonexplorer.ca) our online data visualization tool for open access, up-to-date, and centralized salmon information.

To assess biological status, we compile and synthesize information from several datasets that characterize key salmon population dynamics and temporal trends in fisheries data. These include spawner surveys, observed spawner counts, juvenile surveys, estimates of CU spawner abundance, estimates of total run size, U.S. and Canadian catch, exploitation rate, hatchery release data, and recruits-per-spawner datasets. We then apply a standardized approach to assessing the biological status of each CU, by comparing the current estimated CU spawner abundance, against upper and lower spawner-recruitment or percentiles benchmarks that we derive using a set of decision rules to determine that benchmark most appropriate given the data. A CU is then assigned a "red" status if the current spawner abundance is at or below the lower benchmark. An "amber" status is assigned if the current spawner abundance is above the lower benchmark and at or below the upper benchmark. A "green" status is assigned if current spawner abundance is above the upper benchmark. In all Regions, data limitations for some CUs mean that we are unable to assess the current biological status; therefore, we categorize these CUs as 'data deficient.' For the ~10% of CUs in BC that have status assessments completed by the Department of Fisheries and Oceans Canada (DFO) and/or by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC), we also display the outcome of those status assessments in the Pacific Salmon Explorer.

Due to the release of hatchery-produced salmon in rivers and streams throughout BC, we apply standardized approaches based on DFO methods to assess the current Enhancement Level (High, Moderate, Low, None, Not Assessed) for salmon CUs. Given that the quality of salmon data varies among Regions, species, CUs, and streams, we also apply a standardized approach to assess the quality of data used to estimate spawner abundance and catch for each CU based on a set of criteria outlined in this report. Data for a given CUs was then rated as Poor, Fair, or Good. Evaluations of Enhancement Level and data quality are essential to determine the level of confidence a user should have when interpreting biological data and status assessments for salmon CUs.

To assess habitat status and evaluate individual and cumulative pressures on freshwater salmon habitat, we use 12 habitat pressure indicators (forest disturbance, equivalent clearcut area, insect and disease defoliation, riparian disturbance, road development, water licenses, stream crossing density, total land cover alteration, impervious surfaces, linear development, mining development, and wastewater discharges). We quantify the extent and intensity of each indicator above in every salmon-bearing watershed in BC.

To date, PSF and our collaborators have undertaken biological and habitat status assessments for salmon CUs within the Skeena, Nass, Central Coast, Fraser, Vancouver Island & Mainland Inlets, Columbia, and Haida Gwaii Regions in BC. We assessed the biological status of 339 of the 370 salmon CUs within these seven Regions. Sixty percent of CUs in these Regions are considered data deficient, and two percent are extinct.

A key output of this work is the development of baseline information on the status of salmon populations and their habitats throughout BC. All of the data and assessments developed through this work are integrated into the Pacific Salmon Explorer (salmonexplorer.ca), an online data visualization tool that displays information on salmon populations and their habitats in the Skeena, Nass, Central Coast, Fraser, Vancouver Island & Mainland Inlets, Columbia, and Haida Gwaii Regions. The source datasets are also freely available to the public via our Salmon Data Library (data.salmonwatersheds.ca).

These centralized platforms for storing, distributing, and visualizing salmon-related datasets provide the opportunity to improve access to information, increase the transparency of decision-making, and identify conservation and management strategies that support recovery of at-risk CUs. Our hope is that these snapshots of current salmon status provide a helpful starting point for discussions at local and regional planning tables and enhance the capacity of coastal communities to play a leadership role in the monitoring, assessment, and recovery of Pacific salmon and their habitats.

2.0 Introduction

In British Columbia (BC), salmon data is typically not readily accessible, synthesized in a centralized location, kept up to date, or used to assess biological or habitat status in a standardized way. In the absence of a common baseline understanding of the status of specific salmon populations, it is difficult to make informed, transparent, and evidence-based management and conservation decisions. To address this challenge, the Pacific Salmon Foundation's (PSF) Salmon Watersheds Program has been working since 2008 to improve access to timely information on the biological status of wild salmon and pressures on salmon freshwater habitats through the Pacific Salmon Explorer, an interactive data visualization tool, and a Salmon Data Library. With these tools, we seek to improve access to information in a centralized location, visualize this information in an engaging and useful manner, and inform decision-making processes for salmon conservation and management.

There are several reasons why we are leading this work. First, there is a lack of standardized, readily accessible information about salmon and their freshwater habitats. For example, this work evolved from initial processes undertaken in the Skeena watershed, where a lack of understanding of the state of salmon and their habitats resulted in conflict among management agencies and user groups in regard to fisheries management challenges and potential solutions. Second, this lack of information makes it difficult to determine when and where management actions are needed to improve the status and abundance of salmon populations. Third, limited resources and capacity often result in managers and decision-makers prioritizing where to invest limited resources in Pacific the conservation and management of Pacific salmon. By understanding salmon population status and potential threats to their freshwater habitats, people can better understand what actions might improve outcomes for salmon and where those may be best applied. Providing timely and open-access information can inform strategic planning initiatives for salmon.

The overarching goal of this work is the democratization of information to support science-based conservation and management decisions for salmon. The main objectives of this work are to:

- Strengthen baseline scientific information for Pacific salmon and their habitats,
- Provide timely and standardized assessments of biological status of wild Pacific salmon and pressures on freshwater salmon habitats in BC and the Yukon,
- Make information about Pacific salmon and their habitats broadly accessible, and

➢ Support efforts to integrate this work into conservation, management, and strategic planning initiatives for salmon in BC and the Yukon.

To meet these objectives, the methods that we apply to assess biological and habitat statuses are consistent and transferrable across the Regions in the Pacific Salmon Explorer. Our overall approach is also intentionally iterative and incremental in that we seek and incorporate feedback and improvements to the analytical and communications work that we do. As such, any data that we include in the Pacific Salmon Explorer must be consistently collected, available at broad spatial scales, accompanied by detailed documentation, and allow for reproducibility of analyses (e.g. through code and automation). Finally, for this work to inform conservation, management, and strategic planning efforts, we continue to support and engage in social processes that improve awareness, application, and development of the Pacific Salmon Explorer.

Our efforts to assess biological and habitat status align with Canada's Wild Salmon Policy (DFO, 2005), a science-based framework for monitoring wild Pacific salmon biodiversity across BC and the Yukon. The Wild Salmon Policy seeks to maintain salmon biodiversity through the protection of Conservation Units (CUs). A CU is defined in the Wild Salmon Policy as "*a group of wild salmon sufficiently isolated from other groups that, if extirpated, is very unlikely to recolonize naturally within an acceptable time frame, such as a human lifetime or a specified number of salmon generations"* (DFO, 2005). Fisheries and Oceans Canada (DFO) has defined over 400 CUs in BC and the Yukon based on similarities in their ecology, life history, and genetics (Holtby & Ciruna, 2007). Protecting CUs serves to protect the minimum level of biodiversity required to maintain the resilience of salmon populations.

The Wild Salmon Policy identified six strategies to apply to the conservation and management of salmon. Strategies 1 through 3 focus on improving the current understanding of salmon populations, habitats, and ecosystems through standardized assessment and monitoring. Strategies 4 through 6 focus on management and designing and implementing planning activities that use the baseline information gathered in Strategies 1-3 to manage, maintain, and rebuild salmon CUs and their habitats. The Wild Salmon Policy 2018-2022 Implementation Plan (DFO, 2018) proposed a path forward to implement these strategies. The Pacific Salmon Explorer is part of this implementation plan, understanding that the work of "maintaining and rebuilding salmon populations and their habitats" requires both DFO and effective partnerships.

Working in collaboration with First Nations, DFO, and others, we apply methods consistent with Strategies 1 and 2 of the Wild Salmon Policy to assess the biological and habitat status of salmon CUs. We provide these assessments across Regions delineated by PSF according to watershed and CU boundaries. This technical report provides a detailed overview of our approach and analytical methodologies as a reference document for the Pacific Salmon Explorer. Up-to-date status assessments and data are accessible within this online tool. In the following sections of this report, we detail our general approach, the Regions of BC and Yukon within which we work, our analytical approach, and detailed Region-specific methodologies. We will update this report as data sources, methods, and approaches evolve.

3.0 General Approach

To democratize salmon data and inform decision-making for salmon conservation and management, we have developed two online tools: 1) the Pacific Salmon Explorer and 2) the Salmon Data Library. These tools provide access to baseline information on salmon CUs in BC and the Yukon, assessments of biological status of salmon CUs, and descriptions of pressures on freshwater habitats within CUs across broad spatial scales. Our aim is to establish a legacy of information to inform evidence-based decision-making for salmon conservation and management and help identify opportunities for supporting the recovery of at-risk CUs.

The Pacific Salmon Explorer is a novel online data visualization tool where information about salmon CUs and their habitats is freely and publicly available. The Pacific Salmon Explorer was built by Periscopic Inc. using HTML5 technologies and is driven by a PostgreSQL database developed and maintained by PSF staff. The Pacific Salmon Explorer was initially launched in June 2016, including only the Skeena Region. Since the Pacific Salmon Explorer was developed with extensibility in mind, we added additional Regions to the tool (see Section 5. Regions: Specific Data, Methods, and Results). We will continue to add additional Regions to the tool until all salmon CUs in BC and the Yukon are included.

The Salmon Data Library is a centralized database that hosts all data visualized in the Pacific Salmon Explorer, along with other relevant data on salmon and their habitats in BC. This database, which houses both spatial and non-spatial data, can be accessed via links from the Pacific Salmon Explorer and directly via a URL (data.salmonwatersheds.ca). The interface allows the public to access and search the database online, explore the metadata records for each dataset, and download the datasets directly. In instances where we use an existing publicly available dataset, we provide links to the source data (e.g. to DataBC) so that users can access the most up-to-date authoritative dataset. All non-public datasets available on the Salmon Data Library were shared with PSF with permission and in accordance with relevant data sharing agreements.

Using these two tools, we focus on the following five strategies to achieve our overarching objectives of strengthening and improving access to baseline scientific information for salmon CUs:

1. Compile the best available existing data for Pacific salmon populations and their habitats;
2. Provide data summaries for each CU, including information on abundance, harvest, run-timing, productivity, and trends;

3. Use a suite of indicators to assess the biological status of CUs and the risk of degradation to freshwater salmon habitats from individual and cumulative pressures;
4. Visualize all of the data and assessments on the Pacific Salmon Explorer (www.salmonexplorer.ca); and
5. Make all datasets broadly and freely available via our Salmon Data Library (www.data.salmonwatersheds.ca).

Our approach includes both an analytical component and a social process. First, we invest time and effort to synthesize information on biological and habitat indicators using standardized methodologies. Second, we work with First Nations, Fisheries and Oceans Canada, and other salmon experts from non-profit organizations, the province, municipalities, and independent scientists to solicit feedback and input in order to improve and adapt our approach.

The collaborative nature of this approach involves technical committees within each Region whom we meet with through a series of technical review meetings and specific Advisory Committees who offer advice on our analytical approach. Technical committees are our primary forum for engaging technical review within each region and include fisheries, natural resource, and stewardship experts from First Nations, DFO, the Provincial government, communities, and non-government organizations. technical committees play a critical role in grounding our analyses in local knowledge and expertise. By providing guidance on the project methodology and approach, technical committees also help ensure that results are relevant to local and regional decision-making needs. In addition to working with local project partners via technical meetings, we also engage with local community members and knowledge holders through introductory meetings, webinars, and community meetings to enable a review of salmon spawning locations and provide additional feedback on our overall approach.

We also solicit feedback from salmon experts from DFO, academia, and other organizations to develop our analytical approach and improve specific methodology. Since 2018, our **Population Science Advisory Committee (PSAC)** has helped guide our analytical approach for assessing biological status and developing biological indicators and the visualization of this information in the Pacific Salmon Explorer. We formed the PSAC during our work to add the Fraser Region and Vancouver Island & Mainland Inlets to the Pacific Salmon Explorer (during 2018-2020), but their guidance applies broadly to all Regions. Looking ahead, our Salmon Watersheds Program will be developing a **Habitat Science Advisory Committee (HSAC),** which will provide advice on the data sources, analytical approach, and visualization of the habitat pressure indicators and habitat assessments in the Pacific Salmon Explorer.

In some cases, we have also formed focused working groups to address case-specific data challenges that require further consideration. For example, we formed a **Southern BC Chinook Technical Working Group** in collaboration with DFO to help guide our approach to synthesizing data and assessing biological status of Southern BC Chinook (Korman and English, 2013; Brown et al., 2020).

3.1 Regions in the Pacific Salmon Explorer

Our intent is to complete and maintain assessments of biological status and pressures on freshwater salmon habitats across all salmon CUs in British Columbia and the Yukon. As of 2021, we have applied our approach to three major salmon-bearing watersheds within BC (the Skeena, Nass, and Fraser Rivers), as well as a number of smaller watersheds that drain into the Pacific Ocean along the Central Coast, North Coast, Haida Gwaii, Vancouver Island and southern mainland inlets of BC, and the upper reaches of the Columbia River within Canada. In the near future, we aim to apply our approach to the last remaining Pacific Regions, which include the salmon-bearing watersheds along the transboundary region with Alaska (i.e. Unuk, Stikine, Whiting, Taku, Chilkat, Alsek) and those within the Yukon Territory.

For these assessments, we have delineated assessment **Regions** that are unique to our approach. Many salmon CUs span a diversity of watershed, social, political, and administrative borders; therefore, it is not generally possible to fit CUs within well-known regional boundaries. By identifying Regions with geographic boundaries primarily based on CU boundaries, we have prioritized salmon and the ecological and genetic similarities of salmon populations that make up CUs as our regional borders. In addition to CU boundaries, we also consider the adjacency of a Region to past and future study Regions to minimize regional overlap and consider major drainage patterns represented by the provincial Freshwater Atlas 1:20,000 Watershed Groups.

3.1.1 Conservation Units in the Pacific Region within the Pacific Salmon Explorer

In the Pacific Region (British Columbia and the Yukon), CUs are defined by DFO according to the methodology developed by Holtby and Ciruna (2007) to describe the genetic diversity of wild salmon. In total, 430 CUs were identified across BC and the Yukon (Holtby & Ciruna, 2007; Appendix 1). Since developing the Pacific Salmon Explorer, we have based our lists of CUs on this original list (Holtby & Ciruna, 2007) and incorporated expert guidance from our technical committees to refine these lists (see Section 5. Regions: Specific Data, Methods, and Results for specific details). Given that new information has continued to become available since that initial list, in 2019, DFO released a structured framework for reviewing and approving revisions to the current list of CUs (Wade et al., 2019). This process recognizes the need for a formalized process for reviewing and updating CUs in a standardized and consistent manner.

4.0 Analytical Approach: Using Indicators to Inform the Status of Salmon Conservation Units and their Habitats

We apply a suite of indicators to assess both the biological and habitat status of salmon CUs. Defined as "*measures of pressures, states, and/or responses*," indicators depict the condition of species, habitats, and/or systems to improve one's understanding of the linkages among drivers, stressors, conditions, and management actions (ESSA, 2020). The indicators and approach that we use align with Strategies 1 and 2 of the Wild Salmon Policy (DFO, 2005) that call for standardized assessment and monitoring of the salmon CUs and their freshwater habitats Holt et al., 2009; Stalberg et al., 2009).

Relevant salmon indicators for informing biological and habitat status have several criteria:

- They are measurable, relevant to the health and persistence of salmon as they characterize either key population dynamics or habitat conditions;
- The data are available over broad spatial and temporal scales;
- The data are updated consistently;
- The data have consistent collection protocols;
- The data are in a format that allows easy integration into PSF's data systems;
- The indicators can be tracked over time;
- They can be used to inform management decisions for threatened or at-risk salmon CUs

To quantify the suite of biological and habitat status indicators that we use, we have continued to lead a major effort to compile and synthesize salmon-related data in each of the Regions where we work in. While a large amount of salmon-related data already exists, they are often not readily available, not well documented, and not compiled in a single location. Our efforts focus on bringing existing information together in a standardized format into a single, centralized location (i.e. the Salmon Data Library) and summarizing the data in valuable ways for monitoring and assessing salmon CUs and their habitats (i.e. the Pacific Salmon Explorer).

We then calculate and apply benchmarks for each indicator to assess status using a 'stoplight' approach. The result is a qualitative assessment of each indicator as either red, amber, or green, depending on the current data relative to a lower or upper benchmark (Figure 1). The intent is that decision-makers can then apply management measures to improve the status of a CU and/or salmon-bearing watershed, for example, from Red to Amber or Amber to Green (DFO, 2005).

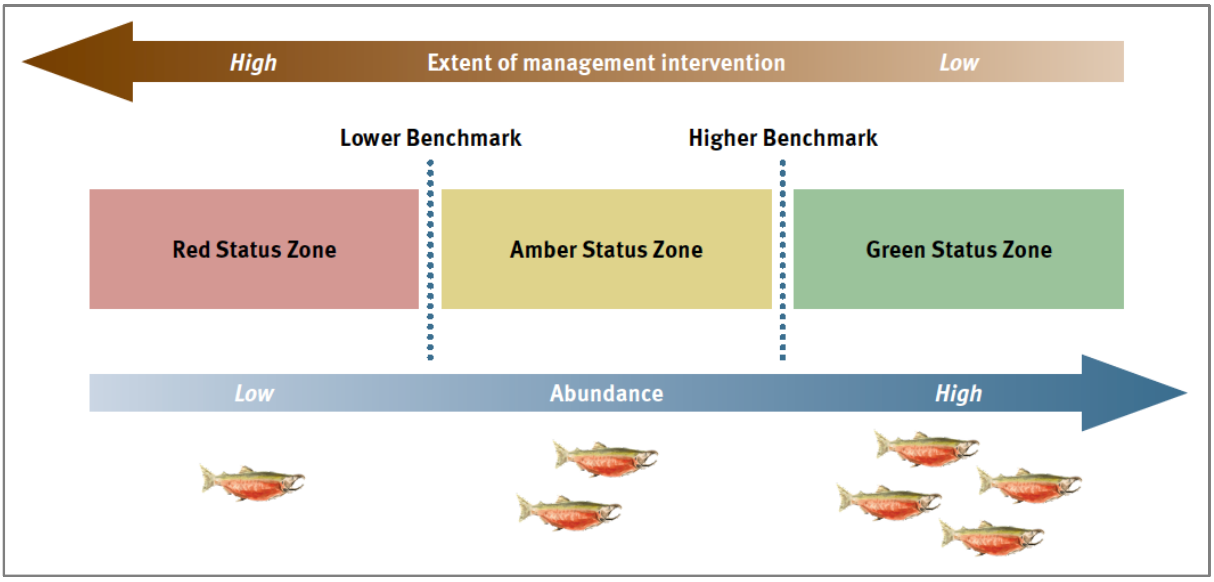

Figure 1. Benchmarks and biological status zones under the Wild Salmon Policy (DFO, 2005).

4.1 Indicators and Benchmarks for Assessing Biological Status

The biological status assessments that we complete and visualize on the Pacific Salmon Explorer are guided by the approaches recommended under Strategy 1 of the Wild Salmon Policy (DFO, 2005) and by Holt et al. (2009), as well as additional recommendations from our independent Population Science Advisory Committee. Candidate benchmarks for evaluating the status of CUs have been proposed for four classes of indicators (Holt et al., 2009), which include:

1. Current spawner abundance;
2. Trends in spawner abundance over time;
3. Distribution of spawners within the CU; and
4. Fishing mortality relative to stock productivity.

In order to characterize key salmon population dynamics, temporal trends in fisheries data, and assess the biological status of salmon CUs across the Pacific Region, we compile and synthesize the following information:

- spawner survey locations,
- observed spawner counts in indicator and non-indicator streams,

- juvenile surveys in streams,
- estimates of spawner abundance at the CU-level,
- estimates of total run size,
- U.S. and Canadian catch,
- exploitation rate,
- hatchery release data, and
- recruits-per-spawner datasets.

The data sources and synthesis vary between the North and Central Coast (Nass, Skeena, Central Coast Regions) and the South Coast (Fraser and Vancouver Island & Mainland Inlets Regions). Region-specific data nuances are included in Section 5. Regions: Specific Data, Methods, and Results.

We use these synthesized data to generate output datasets that are available for download in the Salmon Data Library and figures for the eight biological indicators presented in the Pacific Salmon Explorer. This data compilation exercise also helps identify data gaps across and within Regions. We aim to update these key datasets annually or as new data become available.

4.1.1 Overview of Biological Indicators

We use eight indicators to characterize the dynamics and status of each Conservation Unit in the Pacific Salmon Explorer. These indicators provide information on the current state of salmon CUs and trends over time. Here, we describe the general approach we take to synthesizing and visualizing these biological indicators. We have documented specific nuances for each region below (see Section 5: Regions: Specific data, Methods, and Results).

A: Spawner Surveys

Spawner surveys are the counts of observations of the number of spawning salmon in a specific stream each year. Spawner surveys are a fundamental piece of information for assessing the status of salmon CUs over time. We use the spawner survey data from the New Salmon Escapement Database (NuSEDS) to visualize spawner surveys' spatial and temporal coverage for each CU in the Pacific Salmon Explorer and show data by stream and by year.

DFO across Regions has identified both indicator and non-indicator streams. Indicator streams are more intensively and consistently surveyed using methodologies that provide relatively accurate annual abundance estimates. Therefore, indicator streams are understood to provide more reliable indices of abundance and are assumed to be representative of returns to other streams nearby (English et al. 2016). Non-indicator streams tend to have less consistent survey coverage, more variable survey methods, and/or may be more difficult to survey. A number of both indicator and non-indicator streams within a CU may be surveyed in a given year.

A variety of methods are used to survey spawners in both indicator and non-indicator streams, which vary by species, CU, and stream. Estimated spawner counts can be produced from a single visual survey of a stream by foot, by counting fish through a complete counting fence, or by aerial (helicopter) surveys. Survey methodology can also change over time according to changes in capacity and funding; for instance, some streams that were historically monitored by visual surveys on foot are now enumerated via a counting fence or aerial surveys (see Data Quality section below).

B: Spawner Abundance

We visualize both observed and estimated **spawner abundance** on the Pacific Salmon Explorer. This indicator provides estimates of the total numbers of spawners that return to spawn each year for each CU. Observed spawner abundance is the sum of all spawner survey data as documented in NuSEDS, while estimated spawner abundance generally accounts for streams that are not surveyed in a given year by following infilling procedures. These infilling procedures are region and species-specific and are documented in Section 5. Regions: Specific Data, Methods, and Results. Unless specified otherwise, estimated CU-level spawner abundance values are used as inputs in the Trends in Spawner Abundance, Catch and Run Size, and Recruits-per-spawner indicators described below and when assessing biological status for each CU (see Appendix 4).

C: Run Timing

Run timing is estimated using a range of methods, including models based on daily counting fence data to expert judgment reporting mean and standard deviation of the annual return time for each CU. Where these data are available, we visualize the modeled (using a normal distribution) peak return timing at a CU-level to river entry.

D: Catch & Run Size

Catch estimates report the number of adult salmon caught in commercial (including both Canadian and U.S.), recreational, and First Nations food, social, and ceremonial (FSC) fisheries. **Run Size** refers to the number of adult salmon that return from the ocean in a given year, including both escapement (i.e. estimated spawner abundance) and those that are caught (i.e. catch) at a CU-level. The **exploitation rate** is calculated as the proportion of a given run caught in all fisheries. This indicator provides important information on the long-term harvest rate of each CU, which has implications for the number of salmon returning to spawning grounds over time.

E: Recruits-per-Spawner

Recruits-per-spawner estimates the number of adult salmon produced per spawner in the previous generation. This indicator provides valuable information on the recruitment of salmon within a CU when calculations are available over the long term. This can improve our understanding of survival within and among CUs. If the number of recruits-per-spawner is below one, the number of salmon will decline over time. For species with variable age-at-return, estimating the number of recruits for a given brood year requires information on run size and the distribution of ages of returning fish over multiple years. Recruits-per-spawner is then calculated as the number of recruits divided by the number of spawners for each brood year, based on CU-level estimates of spawning abundance. This indicator is relatively data-intensive and requires information on total run size, spawner abundance, and the ages of salmon returning to spawn.

F: Trends in Spawner Abundance

Trends in spawner abundance is an estimate of spawner abundance at a CU-level over the existing time series. This indicator highlights long-term fluctuations in abundance that could otherwise be masked by high interannual variability in population abundance. On the Pacific Salmon Explorer, we show the trends in spawner abundance over the entire time series of available data, as well as the last three generations, which aligns with the Committee on the Status of Endangered Wildlife in Canada (COSEWIC). Assuming the data are reliable, considering trends in population abundance over longer time periods may be more likely to detect true changes in abundance and trigger an appropriate management response (d'Eon-Eggerston et al., 2015; Porszt et al., 2012).

G: Juvenile Surveys

Juvenile abundance estimates typically show the number of out-migrating smolts that were counted in a given year for each stream within a CU (where available). We also calculate the geometric mean of smolt abundance as it is less sensitive to infrequent high abundance years.

H: Hatchery Releases

While salmon hatcheries play a role in the conservation and management of Pacific salmon, salmonid enhancement can also pose risks to wild salmon. Juvenile hatchery fish can outcompete wild juveniles for limited food resources, and there is increasing evidence that high hatchery salmon abundance at sea is related to decreased wild salmon productivity due to limitations of ocean carrying capacity (Ruggerone & Irvine, 2018; Connors et al., 2020). Hatchery-produced spawners can also reproduce with wild salmon, with implications for genetic diversity and productivity of wild populations. Hatchery-produced fish can also exacerbate issues in mixed-stock fisheries, which can affect threatened or at-risk salmon populations. Given these concerns and other potential impacts of hatcheries on wild salmon abundance and productivity, we visualize **hatchery information,** including hatchery locations, type of hatchery, hatchery fish release sites, number of released hatchery fish, and estimates of **hatchery influence** (see Section 4.1.2. Enhancement Level) on the Pacific Salmon Explorer. For release sites, we show additional information, including the name of the site, the years that site was in use, the type or life stage at which juvenile salmon were released, and the broodstock CU (CU from which the hatchery broodstock originate). Juvenile salmon are released at various life stages and after various hatchery practices (e.g. some juveniles are released in rivers as fed fry, while others are reared for longer in the hatchery and then transferred to a sea pen in the ocean, where they are eventually released) which can affect their survival. Data on hatchery locations, release sites, and release numbers were provided by DFO Salmon Enhancement Program staff.

4.1.2 Enhancement Level

Hatchery operations range in size and production from small to large-scale, with different purposes. There are four types of hatcheries shown on Pacific Salmon Explorer, defined by Fisheries and Oceans Canada's Salmon Enhancement Program (Table 1).

Table 1. Types of Hatcheries operated in BC and visualized on the Pacific Salmon Explorer.

Type of hatchery	Description
Enhancement operations	Major hatcheries with high production
Community economic development	Smaller-scale community-based hatcheries
Designated public involvement	Similar to community economic development but smaller
Public involvement unit	Very small-scale hatcheries

These hatcheries release hatchery-produced salmon throughout streams in BC, resulting in salmon populations that are considered 'enhanced' to varying degrees. We assess and display the current Enhancement Level for salmon CUs based on a standardized approach that draws on the best available data for all spawning streams within CUs across BC. **Enhancement Level** is a measure of the extent of enhancement (e.g. from hatcheries) that has recently occurred within a CU.

The determination of enhancement levels begins with individual spawning streams (indicator and non-indicator), where we assess Stream Enhancement Level based on methods developed by DFO (Brown et al., 2019, 2020). We developed Stream Enhancement Level classifications based on the intensity of recent enhancement activity within each CU (High, Moderate, Low, None, Not Assessed; Table 2). Here, High and Moderate correspond with streams that have significant enhancement, while Low and None are streams with minimal enhancement. In contrast to Brown et al. (2019), we assess Stream Enhancement Level over the previous *two generations* in alignment with the definition of wild salmon under Canada's Wild Salmon Policy.

Table 2. Stream Enhancement level categories for spawning streams.

Stream Enhancement Level	Definition
None	No records of enhancement
Low	No records of enhancement over the previous two generations
Moderate	Less than 25% enhancement over the previous two generations
High	More than 25% enhancement over the previous two generations
Not Assessed	The Enhancement Level for this Conservation Unit has not been assessed

Assessments of Stream Enhancement Level are based on three criteria: 1) the number of coded wire tags (CWT) recovered from spawners; 2) the number of juveniles released from hatcheries within the CU; and 3) the number of fish collected for broodstock. If CWT-based estimates are available, then we use that value for the Stream Enhancement Level for the spawning stream. Otherwise, we use the highest number from either the number of juvenile releases or the number of collected broodstock to quantify a Stream Enhancement Level for the given spawning stream. For example, if more than 25% of spawners have coded wire tags, or more than 25% of years have records of juvenile releases or broodstock collection, then the stream is ranked as High enhancement (Table 3). Data on enhancement for each spawning stream for southern BC Chinook was provided by DFO (Brown et al., 2019, 2020). We generated the Stream Enhancement Level based on these values. For other species and CUs, we generated Stream Enhancement Level based on data provided by DFO's Salmon Enhancement Program.

We then calculate a CU Enhancement Level score using the weighted average of the contribution of spawning streams with Moderate or High enhancement to each CU. This CU Enhancement Level score is calculated according to

$$c = \frac{\sum x_i}{\sum x_n}$$

where x_i is the geometric mean of the number of spawners at the spawning streams where the Stream Enhancement Level is Moderate or High (over the most recent two generations), and x_n is the geometric mean of the number of spawners at all spawning streams (over the most recent two generations).

Finally, we assign and display a CU Enhancement Level ranking based on the proportion of adult salmon across an entire CU that spawn in streams with varying enhancement levels (Table 3). Note that the CU Enhancement Level displayed may not reflect current enhancement levels (e.g. from hatcheries) within a CU since this assessment is based on enhancement activities that have taken place over the most recent two generations.

Table 3. CU Enhancement Level ranking categories, as generated based on the categories in Table 2 for individual spawning streams.

CU Enhancement Level	Definition
None	There are no records of enhancement for this Conservation Unit.
Low	c=0. There are no records of enhancement for this Conservation Unit over the most recent two generations.
Moderate	c=0.01-0.25. Over the most recent two generations, less than 25% of all spawners within the Conservation Unit are from enhanced sources.
High	c=0.26-1.0. Over the most recent two generations, more than 25% of all spawners within the Conservation Unit are from enhanced sources.
Not Assessed	The Enhancement Level for this Conservation Unit has not been assessed.

4.1.3 Data Quality

The quality of salmon data shown in the Pacific Salmon Explorer varies widely amongst Regions, species, Conservation Units, and streams. For instance, counts of spawning salmon obtained from a single aerial survey are less reliable than counts obtained from an unbroken counting fence. We combine spawner survey data with other datasets, such as catch, to determine total run size and to assess the biological status of CUs. As such, measures of **data quality** are important for determining the level of confidence a user should have in the data and supporting analyses shown in the Pacific Salmon Explorer.

We developed a standardized approach to assess the quality of data used to estimate spawner abundance and catch for each Conservation Unit, based on four criteria: 1) Spawner Survey Method, 2) Spawner Survey Coverage, 3) Spawner Survey Execution, and 4) Catch Estimation Method (Table 4). We apply scores of 0-5 to each of these four criteria and present the sum of all four criteria as the Overall Spawner Abundance and Catch Data Quality for each CU. We then translate the final scores into categories of Poor (1-7), Fair (8-14), or Good (15-20) that are displayed on the Pacific Salmon Explorer. A score of 0 means that there were no data to assess. More information on our data quality scoring methods for each criterion and the Overall Spawner Abundance and Catch Data Quality are described below.

Note that our current data quality assessments do not consider the quality of benchmarks used to assess Biological Status; however, this is an additional aspect of data quality that we would like to explore in the future.

Table 4. Summary of the four criteria used to score overall CU-level data quality, based on the quality of data on spawner abundance and catch estimates.

Category	Criteria	Description
Spawner Survey Data	Spawner Survey Method	This criterion indicates the quality of spawner survey data, based on the survey methods and sampling effort across all indicator streams within this CU over the most recent generation.
	Spawner Survey Coverage	This criterion indicates how representative spawner surveys are of the CU, measured as the proportion of total spawners that spawn in indicator streams.
	Spawner Survey Execution	This criterion indicates how consistently the indicator streams for the CU have been surveyed, measured as the proportion of indicator streams that were monitored over the most recent generation.

Catch Data	Catch Estimation Method	This criterion indicates the quality of recent catch estimates for the CU, based on a qualitative assessment of the rigour of the catch estimation method in the most recent generation.

A: Spawner Survey Method

This criterion indicates the quality of spawner survey data over the most recent generation, based on the survey methods and sampling effort across all indicator streams within the Conservation Unit. The CU-level **Spawner Survey Method** data quality score is calculated as the average of stream-level data quality scores across all indicator streams (as defined by DFO) within the CU. We only quantify data quality for indicator streams because these are the streams that are typically used in expansion and infilling procedures to generate CU-level spawner abundances, while data for non-indicator streams is not directly used.

The stream-level data quality scores that we use to calculate a CU-level Spawner Survey Methods score are recorded by DFO in the NuSEDS database. DFO measures stream-level survey quality on a six-point scale based on a standardized scoring rubric (Table 5). DFO uses this rubric to assess the quality of the spawner count dataset produced each year for each stream, based on survey methodology and effort. These stream-level data quality scores reflect the highly variable spawner abundance data within and across spawning streams, which arises largely from differences in spawner survey methodology. To improve the communication of the stream-level data quality scores, we translate the Estimate Type provided by DFO in NuSEDS into categories labeled as Unknown, Low, Medium-Low, Medium, Medium-High, and High (Table 5).

Table 5. Stream Survey Quality Criteria for the Estimate Classification field in NuSEDS (provided by Bruce Baxter, DFO), showing our categories in the "Data Quality Score on the Pacific Salmon Explorer" column.

Data Quality Score on the Pacific Salmon Explorer	Estimate Type	Survey Method(s)	Reliability (within stock comparisons)	Units	Accuracy	Precision
High	**1** True Abundance, high resolution	Total, seasonal counts through fence or fishway; virtually no bypass	Reliable resolution of between year differences >10%	Absolute abundance	Actual, very high	Infinite (i.e. + or – 0%)

Data Quality Score on the Pacific Salmon Explorer	Estimate Type	Survey Method(s)	Reliability (within stock comparisons)	Units	Accuracy	Precision
			(in absolute units)			
Medium-High	**2** True Abundance, medium resolution	High effort (5 or more trips), standard methods (e.g. mark-recapture, serial counts for area under the curve, etc.)	Reliable resolution of between year differences >25% (in absolute units)	Absolute abundance	Actual or assigned estimate and high	Actual estimate, high to moderate
Medium	**3** Relative Abundance, high resolution	High effort (5 or more trips), standard methods (e.g. equal effort surveys executed by walk, swim, overflight, etc.)	Reliable resolution of between year differences >25% (in absolute units)	Relative abundance linked to method	Assigned range and medium to high	Assigned estimate, medium to high
Medium-Low	**4** Relative Abundance, medium resolution	Low to moderate effort (1-4 trips), known survey method	Reliable resolution of between year differences >200% (in relative units)	Relative abundance linked to method	Unknown assumed fairly constant	Unknown assumed fairly constant
Low	**5** Relative Abundance, low resolution	Low effort (e.g. 1 trip), use of vaguely defined, inconsistent, or poorly executed methods	Uncertain numeric comparisons, but high reliability for presence or absence	Relative abundance, but vague or no i.d. on method	Unknown assumed highly variable	Unknown assumed highly variable
Low	**6** Presence or Absence	Any of above	Moderate to high reliability for presence/absence	(+) or (-)	Medium to high	Unknown

Data Quality Score on the Pacific Salmon Explorer	Estimate Type	Survey Method(s)	Reliability (within stock comparisons)	Units	Accuracy	Precision
Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown

To then determine CU-level Spawner Survey Method data quality scores (Q), we calculate a weighted average of the stream-level survey method data quality scores across all indicator streams over the most recent generation within the CU (Table 6). Where there are known issues with DFO's indicator stream list in NuSEDS, we manually override those data quality scores and substitute expert derived assessments of data quality based on expert knowledge of spawner survey methods. We do not include survey years where spawner survey methods are Unknown. We then translate the CU-level Spawner Survey Methods score into a scale of 0-5 (labeled as Not Applicable, Low, Medium-Low, Medium, Medium-High, And High; Table 6). Note that this score reflects the reliability of the estimates of current spawner abundance for a CU over the most recent generation and not the reliability of estimates across the entire time series.

Table 6. CU-level Survey Quality scores. Q = CU-level survey quality score (the weighted average of the stream-level survey method data quality values for all indicator streams over the most recent generation).

Score	Definition
0 – Not applicable	No spawner surveys were completed for this Conservation Unit over the most recent generation.
1 – Low	Q≥4.5 and ≤6. Most of the spawner surveys were performed with low-effort or inconsistently executed methods, resulting in variable accuracy and precision.
2 – Medium-Low	Q≥3.5 and ≤4.5. Most of the spawner surveys were performed with medium to low effort, using methods such as a stream walk, swim, or overhead flight, resulting in unknown accuracy and precision.
3 – Medium	Q≥2.5 and ≤3.5. Most of the spawner surveys were performed with high effort, using methods such as a stream walk, swim, or overhead flight, resulting in medium to high accuracy and precision.

4 – Medium- High	Q≥1.5 and ≤2.5. Most of the spawner surveys were performed with high effort, using methods such as mark-recapture, resulting in medium to high accuracy and precision.
5 – High	Q≥1 and ≤1.5. Most of the spawner surveys produce counts of total spawners, using methods such as a fence or fishway, resulting in very high accuracy and precision.

B: Spawner Survey Coverage

This criterion indicates how representative spawner surveys are of the entire Conservation Unit, measured as the proportion of total spawners that spawn in indicator streams. If a CU has a higher proportion of spawners returning to indicator streams. In that case, we assume that the spawner abundance data within that CU is of higher quality since indicator streams are more consistently and reliably surveyed. On the Pacific Salmon Explorer, for the North and Central Coast Regions (Skeena, Nass, and Central Coast), we use the indicator stream list generated and maintained by LGL Ltd (English et al., 2018). We use the indicator stream list provided through the NuSEDS database for all other Regions.

This score is calculated as the average number of spawners in indicator streams divided by the average number of spawners in all indicator and non-indicator streams within the CU, following methods from English et al. (2018). To derive this proportion, we first determine which decade has the greatest coverage of spawner surveys across the indicator and non-indicator streams. We assume that there is a constant proportion of spawners from indicator and non-indicator streams through time. We then calculate the average number of spawners in all indicator and non-indicator streams according to:

$$C = 5 \Big/ \frac{\sum_{i=1}^{I} E_{siady} + \sum_{j=1}^{J} E_{sjady}}{\sum_{i=1}^{I} E_{siady}}$$

where s = *species*, i = indicator stream or river, j = non-indicator stream or river, a = CU, d = decade, y = year, E_{siady} = indicator stream spawners, by stratum and E_{sjady} = non-indicator stream spawners, by stratum. This approach is used because it provides a weighted average of the actual number of spawners enumerated with higher quality methodology, rather than only counting the number of indicator and non-indicator streams. We then translate the **Spawner**

Survey Coverage score into a scale of 0-5 (labeled as Not Applicable, Low, Medium-Low, Medium, Medium-High, and High; Table 7).

For CUs that do not use expansion procedures to generate CU-level estimates (e.g. Fraser sockeye, Chinook, and coho, and Vancouver Island & Mainland Inlets Chinook), Spawner Survey Coverage scores were generated via expert opinion.

Table 7. Spawner survey coverage scores.

Score	Definition
0 – Not applicable	No spawner surveys were completed for this Conservation Unit.
1 – Low	1-30% of spawners within the Conservation Unit are represented by indicator streams.
2 – Medium-Low	30-49% of spawners within the Conservation Unit are represented by indicator streams.
3 – Medium	50-69% of spawners within the Conservation Unit are represented by indicator streams.
4 – Medium- High	70-89% of spawners within the Conservation Unit are represented by indicator streams.
5 – High	90-100% of spawners within the Conservation Unit are represented by indicator streams.

C: Spawner Survey Execution

This criterion indicates how consistently indicator streams for the Conservation Unit have been surveyed over the most recent generation, measured as the proportion of monitored indicator streams. To calculate **Spawner Survey Execution**, we calculate the proportion of indicator streams that are surveyed within the CU in each year of the most recent generation and the generational average of the proportions for each year, according to the following formula:

$$C = 5 \Big/ \frac{\sum_{i=1}^{I} E_{siady} + \sum_{j=1}^{J} E_{sjady}}{\sum_{i=1}^{I} E_{siady}}$$

where *h* is the number of indicator streams surveyed in year *y* of the most recent generation, *m* is the total number of indicator streams, and *n* is the generation length. We then translate the Spawner Survey Execution score into a scale of 0-5 (labeled as Not Applicable, Low, Medium-Low, Medium, Medium-High, and High; Table 8).

Table 8. Spawner survey execution scores.

Score	Definition
0 – Not applicable	No surveys were completed for this Conservation Unit over the most recent generation.
1 – Low	1-20% of all indicator streams in the Conservation Unit were surveyed each year in the most recent generation.
2 – Medium-Low	21-40% of all indicator streams in the Conservation Unit were surveyed each year in the most recent generation.
3 – Medium	41-60% of all indicator streams in the Conservation Unit were surveyed each year in the most recent generation.
4 – Medium-High	61-80% of indicator streams in the Conservation Unit were surveyed each year over the most recent generation.
5 – High	81-100% of all indicator streams in the Conservation Unit were surveyed each year in the most recent generation.

D: Catch Estimates

Catch at the CU-level can be reconstructed using a variety of methods that result in **Catch Estimates** with different levels of uncertainty. This criterion indicates the quality of recent catch estimates for the Conservation Unit in the most recent generation, based on a qualitative assessment of the rigor of the catch estimation method. We calculate this score at the CU-level for the most recent generation based on categories of the type of current catch datasets available on the Pacific Salmon Explorer (Table 9).

Table 9. Catch estimates scores.

Score	Definition
0 – Not applicable	No catch data are available for the Conservation Unit over the most recent generation.
1 – Low	Catch is based on a proportion of catch and/or the exploitation rate in another Conservation Unit or Region (e.g. exploitation for Bella Coola-Dean River coho is assumed to be 60% of the exploitation rate of the Skeena coho).
2 – Medium-Low	Statistical area catch is divided proportionally among all Conservation Units that spawn within the statistical area according to their relative spawner abundance.
3 – Medium	Catch is based on a model that is currently not reproducible or is poorly documented.
4 – Medium-High	Catch is based on a peer-reviewed model of a large portion of known fisheries that the Conservation Unit is exposed to (i.e.>75% of the total catch for this Conservation Unit is expected to be accounted for in most years).
5 – High	Catch is based on a peer-reviewed model of the majority of known fisheries that the Conservation Unit is exposed to (i.e.>95% of catch for this Conservation Unit is expected to be accounted for in most years).

E: Overall Spawner Abundance and Catch Data Quality

We sum the scores from the four criteria above to calculate each CU's overall Spawner Abundance and Catch Data Quality score. This score represents a standardized assessment of the quality of data used to estimate spawner abundance and catch for the Conservation Unit, based on the four criteria above. While this method applies to the available data, it does weigh spawner data more heavily than catch data by a ratio of 3:1.

We then translate the final scores into categories of Poor (1-7), Fair (8-14), or Good (15-20) that are displayed on the Pacific Salmon Explorer (Table 10). A score of 0 means that there were no data to assess.

Table 10. Overall Spawner Abundance and Catch Data Quality Scores.

Sum of Scores from the four Criteria	Score Displayed on the Pacific Salmon Explorer
0	Not Applicable
1-7	Poor
8-14	Fair
15-20	Good

4.1.4 Benchmarks for Assessing Biological Status

In the Pacific Salmon Explorer, we use the current estimated spawner abundance indicator to assess biological status. In collaboration with our Population Science Advisory Committee, we have developed a set of decision rules to guide our approach to assessing biological status for salmon CUs in the Pacific Salmon Explorer (see Section 4.1.5: Decision Rules for Assessing Biological Status). We apply one out of two types of biological benchmarks to quantify the current biological status of CUs, depending on the best available data: (1) spawner-recruitment benchmarks and (2) percentile benchmarks (Figure 2).

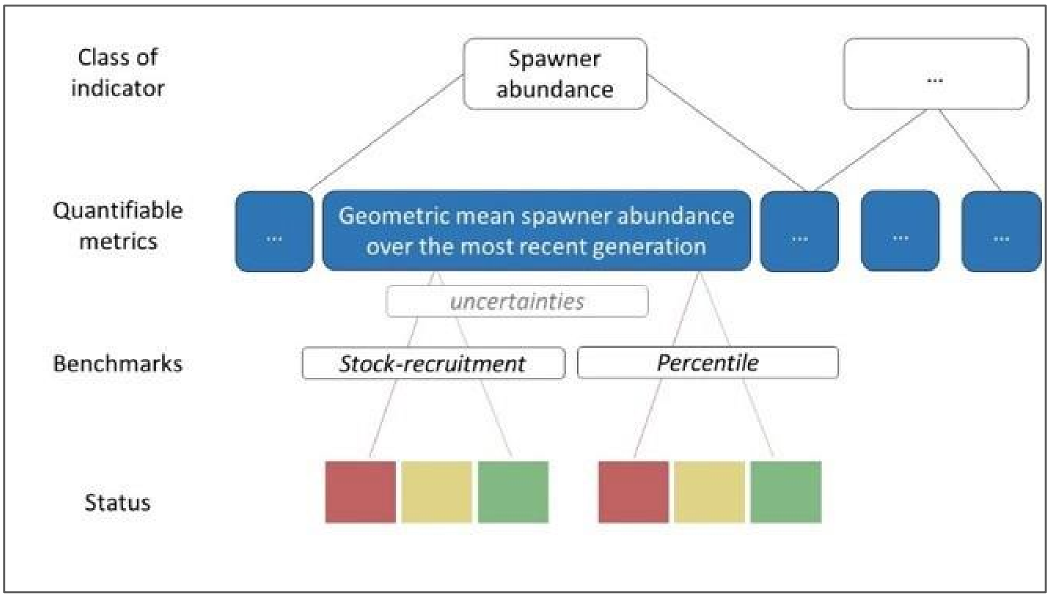

Figure 2. Illustration of the Wild Salmon Policy status assessment framework (adapted from Holt et al., 2009). In order to determine the biological status for a given CU, we focus on the geometric mean spawner abundance (metric, blue) under the spawner abundance indicator.

We assess this metric against two types of benchmarks: spawner-recruitment and percentile. Other boxes (…) represent other types of metrics and indicators that may be included in Wild Salmon Policy status assessments (text adapted from Peacock et al., 2020).

The status of each CU is then assessed by comparing the current spawner abundance, calculated as the geometric mean per generation, to the upper and lower benchmarks. A CU is assigned a "red" status if the current spawner abundance is at or below the lower benchmark. An "amber" status is assigned if the current spawner abundance is above the lower benchmark and at or below the upper benchmark, and a "green" status if it is above the upper benchmark.

As spawner-recruitment benchmarks consider both productivity and carrying capacity of each CU, they are more biologically meaningful, and we aim to apply them whenever possible. However, spawner-recruitment benchmarks require additional data at the CU-level (including age structure and exploitation rates in addition to spawner abundance) that may not be available for a given CU. When these data are not available, we calculate benchmarks based on percentiles of historical spawner abundance, referred to as percentile benchmarks. Percentile benchmarks have been shown to approximate spawner-recruitment benchmarks (Holt et al., 2018). Except for specific cases (detailed below), they can be a suitable alternative to apply spawner-recruitment benchmarks to a CU when the necessary data are unavailable.

A: Spawner-Recruitment Benchmarks

We use a Ricker spawner-recruitment model to describe the spawner-recruitment relationship and define spawner-recruitment benchmarks. We set the upper benchmark as 80% of S_{MSY}, or the spawner abundance predicted to achieve 80% Maximum Sustainable Yield over time. We set the lower benchmark as S_{GEN}, or the spawner abundance predicted to return the population to 80% S_{MSY} in one generation under consistent environmental conditions in the absence of fishing pressure. These benchmarks are consistent with those recommended under the Wild Salmon Policy (Holt et al., 2009). We then determine the biological status of each CU by comparing the geometric mean of spawner abundance over the most recent generation to these upper and lower benchmarks. The model formula is:

$$C = 5 / \frac{\sum_{i=1}^{I} E_{siady} + \sum_{j=1}^{J} E_{sjady}}{\sum_{i=1}^{I} E_{siady}}$$

$$\alpha_i \sim N(\mu_\alpha, \sigma_\alpha),$$
$$\varepsilon_{i,t} \sim N(0, \sigma_{i,t}$$

where i is the index for CU, t is the brood year, R is the recruitment, S is the spawners, and is the productivity (i.e. log of the initial slope of the spawner-recruitment curve) for CU i, is the CU-specific density-dependent term, and is normally-distributed residual error.

We use Hierarchical Bayesian Models (HBMs) to estimate the spawner-recruitment parameters. HBMs are used to model data structured in groups, where different (but related) parameters are generated for each group. Thus, HBMs borrow information from data-rich populations to improve assessments for data-poor ones. These models can be beneficial in data-limited situations and allow for more reliable estimates of spawner-recruitment relationships within a species than non-hierarchical approaches (insofar as the grouped populations experience similar population dynamics). For each Region in the Pacific Salmon Explorer, we use a hierarchical model composed of all CUs of the same species grouped into a single HBM. This approach assumes that CUs within a Region (e.g. Nass, Skeena) share similar productivities. Thus, under the HBM approach, the α_i estimates for each CU come from a common log-normal hyper distribution. Habitat capacity can be used as an informative prior in spawner-recruitment models, and to date, we have used habitat capacity for lake-type sockeye CUs. If habitat capacity data is available and its use is supported by published literature and expert opinion, we use these data as priors in our spawner-recruitment models. If these data are unavailable, we use 1 / mean estimated spawner abundance as the prior for β.

When the productivity (parameter) of CUs is low, S_{GEN} values can become higher than S_{MSY}, producing benchmark values that do not make biological sense (Holt et al., 2018; Peacock et al., 2020). We do not use spawner-recruitment benchmarks in these cases and will instead apply percentile benchmarks.

The color-coded status (red, amber, green) shown on the Pacific Salmon Explorer for the biological status represents the most likely status for the CU, based on the probability of being in each status zone. For example, suppose there is a 20% probability that the status is red (i.e. poor), a 20% probability that the status is amber (i.e. fair), and a 60% probability that the status is green (i.e. good). In that case, the CU is assigned a status of green. 95% credible intervals for the lower and upper spawner-recruitment benchmarks are calculated by taking the 2.5th and 97.5th values from the range of parameter estimates for the benchmarks to give the lower and upper credible interval values, respectively. See Korman and English (2013) for further details, including a discussion of uncertainty and possible biases in benchmarks and status assessments derived from spawner-recruitment models.

B: Percentile Benchmarks

To quantify biological status using percentile benchmarks, we define the lower benchmark as the 25th percentile of historical spawner abundance and the upper benchmark as the 50th percentile of historical spawner abundance, which approximates the upper spawner-recruitment benchmark of 80% S_{MSY} (Holt et al., 2018). We then determine the biological status of each CU by comparing the geometric mean of spawner abundance over the most recent generation to these upper and lower benchmarks. For example, a CU is assessed as 'red' status if the current estimate of spawner abundance is at or below the 25th percentile of historical spawner abundance, 'amber' status if the current average spawner abundance is between the 25th and 50th percentiles of historical spawner abundance, and 'green' status if the current average spawner abundance is at or over the 50th percentile.

We also generate and display 95% confidence intervals around each percentile benchmark using a model-based computational approach to account for autocorrelation in the spawner abundance time series. This approach fits a model to estimate the magnitude of autocorrelation and then re-samples (with replacement) from the fitted residuals to simulate a new data set with temporal autocorrelation. Confidence intervals for percentile benchmarks generated using this approach are the most conservative compared to other potential approaches and perhaps the most appropriate for application to PSF's standardized biological assessments (Peacock, 2020).

C: Additional Status Assessments

In addition to the standardized assessments of biological status developed by the Pacific Salmon Foundation, on the Pacific Salmon Explorer, we also display Wild Salmon Policy (WSP) status assessments completed by Fisheries and Oceans Canada (DFO) and assessments conducted by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC), where available (Appendix 4). About 10% of CUs in BC have status assessments completed by DFO for the WSP and/or by COSEWIC (COSEWIC, 2017; COSEWIC, 2018; Fisheries and Oceans Canada, 2018). These assessments apply multiple metrics and expert judgment to assess status and focus primarily on economically significant Chinook, sockeye, and coho CUs in the Fraser and south coast of BC. When available, we display the WSP and COSEWIC status assessments alongside the standardized status assessments completed by PSF. In some cases, statuses may differ between the different assessments due to varying approaches to status evaluation and/or different years of data being used.

4.1.5 Decision Rules for Assessing Biological Status

Deciding which benchmarks are most appropriate for assessing the biological status of a given CU depends on the available data. With input from the Population Science Advisory Committee, we have developed a set of decision rules to guide how we apply benchmarks to assess biological status for all CUs on the Pacific Salmon Explorer (Figure 3).

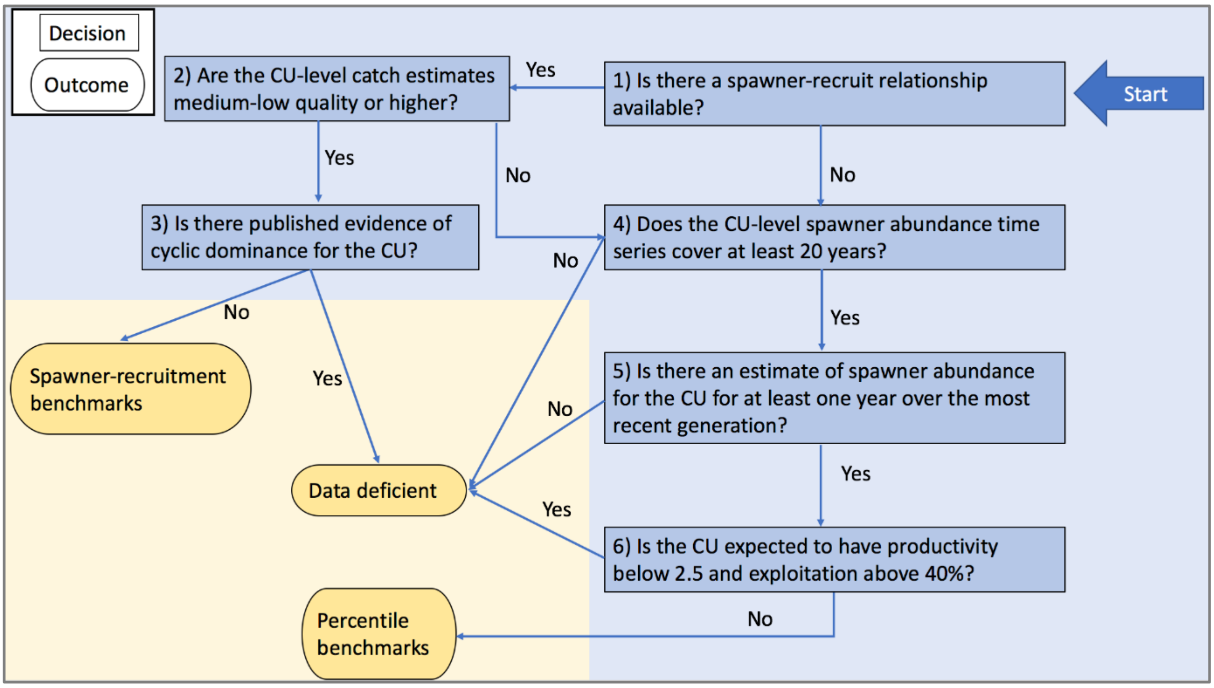

Figure 3. Flowchart for documenting decision rules for quantifying biological status.

We use the following guiding questions to determine which benchmarks to apply given the available data for a CU.

1. *Is there a spawner-recruit relationship available?*

   A spawner-recruitment relationship must be available to calculate spawner-recruitment benchmarks. Most spawner-recruitment relationships have over 10 data points (see Appendix 4).

2. *Are the CU-level estimates of catch of medium-low quality or higher?*

   Errors in estimating catch can lead to misclassification of status using spawner-recruitment benchmarks (Peacock et al., 2020). As such, we do not apply spawner-recruitment when CU-level catch estimates are highly uncertain, i.e. the data quality score for catch estimates is low or medium-low (see Section 4.1.3: Data Quality).

3. *Is there published evidence of cyclic dominance for the CU?*

   Some CUs have population dynamics characterized by cyclic dominance, i.e. there is one very abundant dominant brood line, a sub-dominant brood line, followed by two brood lines with very low abundance. For these cyclically dominant CUs we do not pool data across brood lines to generate estimates of current spawner abundance or to generate CU-level benchmarks as spawner abundance is so different from year to year (Grant et al., 2020). For these CUs, we currently only visualize biological status assessments on the Pacific Salmon Explorer developed through integrated status assessments that incorporate expert judgment and quantitative modeling, where available (e.g. DFO, 2018).

4. *Does the CU-level spawner abundance time-series span at least 20 years?*

   Estimates of spawner abundance over a relatively long time series are required to assess the biological status of a CU. We require a minimum of 20 years of annual estimates of spawner abundance, although we do not require that these estimates are continuous. In some cases, we may use only a subset of the available time series. We do this if expert opinion suggests that using the entire time series is not appropriate.

5. *Is there a spawner abundance estimate at the CU-level for at least one year over the most recent generation?*

   We require at least one annual estimate of spawner abundance over the most recent generation to quantify current spawner abundance. We then take the geometric mean of current spawner abundance over the most recent generation to compare to the estimated benchmarks for that CU to assess biological status.

6. *Is the productivity of the CU expected to be below 2.5 and exploitation above 40%?*

   We do not apply percentile benchmarks if productivity is low (<2.5) and fisheries exploitation is high (>40%). In these cases, percentile benchmarks can result in biological status assessments that are overly optimistic and, therefore, risky from a long-term management perspective (Holt et al., 2018; Peacock et al., 2020).

For a number of CUs across all Regions, data limitations mean that we cannot assess the current biological status; therefore, we categorize these CUs as ‘‘data deficient’’. We consider three types of data deficiencies when assessing biological status for the Pacific Salmon Explorer. First, some CUs have no available run reconstruction and, therefore, no CU-level spawner abundance estimate. This could be because there is no data for that CU in NuSEDS, meaning there has been no record of spawner surveys conducted for the CU since 1954. This could also be because the CU does not have an identified indicator stream, which means that CU-level estimates of spawner abundance cannot be estimated, and biological status cannot be assessed. Second, some CUs may have no data on spawner abundance for the most recent generation. This means that we cannot generate an estimate of current abundance to compare against the benchmarks to assess biological status. Finally, we may have sufficient data (i.e. run reconstructions) to assess biological status using our methods in some cases.

Still, expert advice from our technical committees and Population Science Advisory Committee suggests that we do not. This can be due to the complexity of a species or CU life history (e.g. Fraser River cyclic sockeye CUs; see Fraser Region; Grant et al., 2020), other data challenges, or assumptions that are currently a barrier to applying our standardized approach.

Given the iterative and incremental development approach that we take to visualizing salmon data and assessing biological status, the current set of decision rules outlined in this technical report are subject to change to ensure that our methods align with current best practices for quantifying biological status. As such, the methods and decision rules presented here diverge from previously published PSF technical reports documenting our approach to assessing biological status in specific Regions (Connors et al., 2013; Connors et al., 2018; Connors et al., 2019).

4.1.6 Extinct, *De Novo,* and Transplant CUs

Over time, DFO may re-classify CUs in several ways: 1) if CU-level spawner abundance declines to a point where the CU is lost ("extinct"), 2) if a CU is extinct and then re-introduced with different genetic stock ("*de novo*"), or 3) if a CU is created by introducing populations to a where they were not previously present ("transplant"). We visualize these categories on the Pacific Salmon Explorer, intending to maintain a historical record of Pacific salmon's changing genetic diversity and abundance (see Appendix 1 and Appendix 4).

4.1.7 Limitations: Biological Indicators & Assessment Approach

There are a number of limitations to the biological status assessments that we visualize on the Pacific Salmon Explorer. Some limitations, such as CU-level estimates of spawner abundance, developing benchmarks, and monitoring coverage, apply to all species and Regions. These caveats should be considered when interpreting the biological status assessments' results and applying them to future research priorities.

A: CU-level Estimates of Spawner Abundance

If a complete census or true count of spawners is not available for all streams within a CU, DFO applies expansion factors to generate CU-level estimates of spawner abundance. The number of indicator streams that are counted in a given year for each CU (spawner survey coverage) has been declining since the late 1990s in many Regions included in the Pacific Salmon Explorer (e.g. English et al., 2018), resulting in an increasing magnitude of this extrapolation from spawner counts at monitored streams to CU-level estimates of spawner abundance. As fewer indicator streams are used to represent what we know about spawner abundance for a potentially large and complex CU, it has become increasingly difficult to know how many spawners are returning. This could be particularly problematic if the contribution of streams within a CU as related to overall abundance changes through time. The expansion factor approach applied by DFO is generally recognized as the best practice for generating CU-level estimates of spawner abundance in many cases (e.g. on the North and Central Coast; English et al. 2012). Our work aims to derive biological status assessments of individual CUs relative to different metrics and not, for example, to set management targets or catch allocation, so the assumptions that support these expansion procedures should not overly influence this work.

In addition, recent simulation analyses to determine the influence of these expansion factors on biological status assessments using our approach found that they were robust to a range of expansion procedures (Peacock et al., 2020). Peacock et al. (2020) suggests that, under certain conditions, declining monitoring coverage (to a point) has little impact on the accuracy of benchmarks or biological status assessments using our methods. We have also attempted to account for differing levels of monitoring coverage as part of our work to quantify data quality for visualization on the Pacific Salmon Explorer (see Section 4.1.3. Data Quality).

B: Refining benchmarks

We have developed the benchmarks that we apply to assess biological based on the best available recent literature and in consultation with our Population Science Advisory Committee. However, there are still alternative approaches that we could consider, and we will continue to apply best practices and our iterative approach to the application of benchmarks to deriving biological status. For example, if available, habitat-based benchmarks (e.g. Parken et al., 2006) could be applied to situations where other biological benchmarks cannot be used.

C: Other limitations

Other limitations are species- or Region-specific; Region-specific limitations are included below in Section 5. Regions: Specific Data, Methods, and Results.

4.2 Indicators and Benchmarks for Assessing Habitat Status

Our assessments of habitat status that we complete and visualize on the Pacific Salmon Explorer follow the approaches developed for evaluating status under Strategy 2 of the Wild Salmon Policy (DFO, 2005). Following this guidance, monitoring should be informed by information on a suite of habitat indicators. **Habitat indicators** provide a measure of the characteristics of the environment, such as the habitat condition, magnitude of stress, degree of exposure to a stressor, or ecological response to exposure. To evaluate the potential risk of degradation to freshwater salmon habitat, each indicator should be relevant to salmon and represent a clear scientific understanding of either a direct or an indirect relationship between itself and its impact on salmon.

Habitat indicators can be further described as either pressure indicators or state indicators following the two-tiered pressure and state indicator framework described by Stalberg et al. (2009). **Pressure indicators** are natural processes or human activities that can directly or indirectly induce qualitative or quantitative changes in environmental conditions (Stalberg et al., 2009). **State indicators** are physical, chemical, or biological attributes measured to characterize environmental conditions on the ground (Stalberg et al., 2009). Distinguishing features between pressure and state indicators include the scale of assessment, the resolution of input data, and the cost of assessment and monitoring. Pressure indicators are often assessed for large geographic areas using remotely sensed information. Pressure indicators evaluation and quantification of pressure indicators are less resource intensive because data collection and monitoring are typically not based on on-the-ground field studies.

On the other hand, state indicators are assessed for smaller geographic areas, often require higher resolution data to evaluate and quantify, and require more resources as they often require on-the-ground fieldwork. Our work to date focuses on pressure indicators as the first step to gaining a regional-scale understanding of habitat conditions over broad geographic extents. Our intent and ambition are for these assessments of habitat pressure indicators to lead to the identification of priority areas to conduct finer-scale state indicator assessments and monitoring.

Through an expert-guided process as part of our work in the Skeena Region (Porter et al., 2013a; Porter et al., 2014), we identified 12 habitat pressure indicators: forest disturbance, equivalent clearcut area, insect and disease defoliation, riparian disturbance, road development, water licenses, stream crossing density, total land cover alteration, impervious surfaces, linear development, mining development, and waste water discharges. We assess these 12 habitat indicators individually and cumulatively for every salmon-bearing watershed in BC.

4.2.1 Scale of Habitat Assessments

The base reporting unit for our assessments of habitat pressure indicators is the 1:20,000 Freshwater Atlas (FWA) assessment watersheds dataset (MOE, 2017a). The Freshwater Atlas is the most comprehensive, standardized source of hydrologic features in BC. The FWA assessment watersheds dataset is a commonly used provincial baseline dataset for resource managers, researchers, and others interested in evaluating and reporting at a watershed scale. The FWA assessment watersheds replace the legacy 1:50,000 BC Watershed Atlas Third-

Order Watersheds dataset. Assessment watersheds are delineated at a scale where hillslope and channel processes are generally well linked, between 2,000 to 10,000 hectares (Carver & Gray 2009).

4.2.2 Identifying Salmon Spawning Habitat

Our assessment methodology uses the concept of a **zone of influence (ZOI)** to identify the area of land considered to influence freshwater salmon habitat. Using ZOIs to assess salmon freshwater habitats aligns with Strategy 2 of the Wild Salmon Policy, in that 1) the identification of habitats that support or limit salmon production is necessary to inform assessment, monitoring, and protection priorities; and 2) that habitat requirements vary by species, life history characteristics and phase, and geography (DFO, 2005).

- We define ZOIs for the spawning life stage for each salmon CU. A **spawning ZOI** represents the area of land that drains into the spawning habitat of a specific salmon CU.

We use the geographic extents of ZOIs to assess and quantify habitat pressures by CUs for the spawning life stage. The specific rules for defining ZOIs were developed in collaboration with PSF's Skeena Technical Advisory Committee (Porter et al., 2013a; Porter et al., 2014) and are defined in Appendix 5 with species and Region-specific nuances, where relevant.

4.2.3 Mapping Salmon Spawning Locations

We need to know where salmon spawn to identify ZOIs and assess pressures on salmon spawning habitats. We use spawning location data to identify and delineate salmon spawning habitats, identify upland areas that may impact spawning habitats, and use this information to determine the relevant spatial extent for habitat assessments. We identify salmon spawning locations using several key data sources: The Fisheries Information Summary System (FISS) database, technical reports, maps, additional databases when available, and local knowledge derived through expert elicitation.

A: Fisheries Information Summary System

The FISS database is a legacy project which was a jointly funded initiative between BC Fisheries and DFO, intending to provide fish habitat data for water bodies throughout BC and the Yukon (MOE, 2017b). FISS data is distributed under two datasets via DataBC on the BC Data Catalogue. The two datasets, specifically, are "BC Historical Fish Distribution Zones (50,000)" and "Known BC Fish Observations and BC Fish Distributions." The latter dataset, the Known BC Fish Observations, and BC Fish Distributions, carries the description on DataBC as "the most current and comprehensive information source on fish presence for the province."

As of 2001, the Province of BC no longer maintains the spawning zones or linear distribution dataset ("BC Historical Fish Distribution - Zones (50,000)"), but the Known BC Fish Observations and BC Fish Distributions dataset is an actively maintained dataset. This dataset houses the legacy FISS data as well as data from other provincially maintained sources. However, efforts to maintain fish location data are not standardized province-wide, and thus both data coverage and accuracy vary across BC. The province continues to document ongoing data submissions from organizations or individuals required to report fisheries data and sampling information as part of the reporting requirements for a Scientific Fish Collection Permit (a permit to capture or collect fish specimens for scientific or other non-recreational or commercial purposes). The province also documents submissions of non-permitted fish and fish habitat information on a voluntary basis. While there are some challenges with these datasets, we use these datasets as a base representation of spawning locations as these two datasets are the most comprehensive source of spawning data available province-wide. We filtered these datasets to Pacific salmon species and spawning activity types to identify spawning locations.

B: Additional Technical Reports, Maps, and Databases

In some Regions, we have worked with technical committees and local salmon experts to identify additional spawning or habitat information available within technical reports, previously published maps, and other databases (see Section 5. Regions: Specific Data, Methods, and Results).

C: Expert-elicited Spawning Location Information and Data Review

Given the limitations of the provincially available datasets, we work with local expert knowledge holders in each Region to review and supplement the existing spawning location information using hard copy paper maps and our ESRI-based mapping platform, the Salmon Habitat Mapper (Figure 4). We use a structured process whereby we 1) compile large-format paper maps of each study area which include spawning location data, and 2) use the Salmon Habitat Mapper, a private online tool that we developed for exploring and contributing spawning data. Using these two tools, we work with project partners with local knowledge of where salmon spawn in each Region to review the existing spawning location data and augment those data with additional sites of known spawning locations. These review sessions typically include both fisheries staff and community members who work with us over a day-long workshop in their local area within a Region. Any additional data documented via the large-format paper maps are then digitized and integrated, along with data collected via the Salmon Habitat Mapper, into our spawning locations dataset.

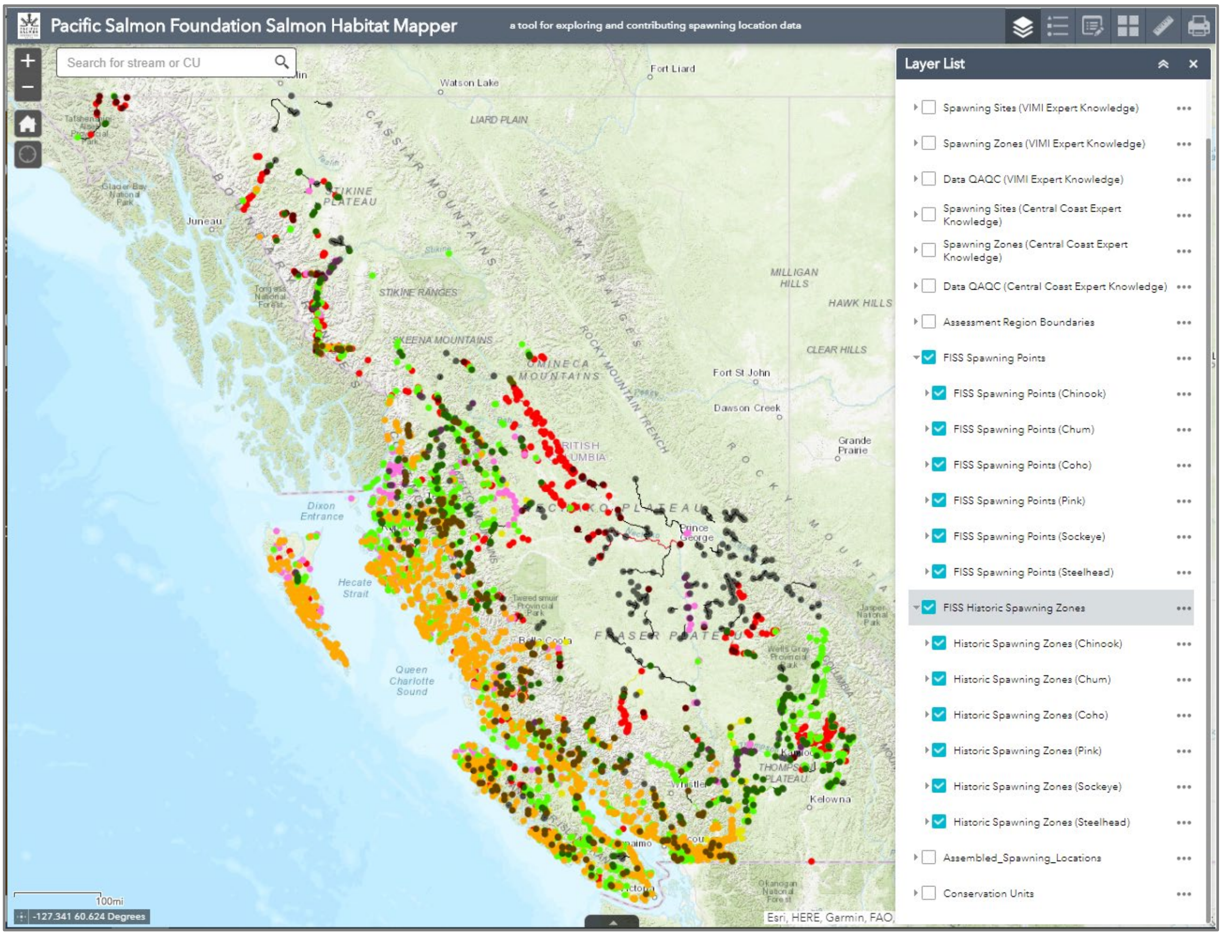

Figure 4. Salmon Habitat Mapper: A Collaborative Tool for Mapping Salmon Spawning Habitats.

D: Assigning Spawning Locations to Conservation Units

For all spawning location information, we assign spawning locations to individual CUs. For all species except lake-type sockeye, we assign spawning locations to CUs by determining which CU a spawning location was located within. This is done on a species-specific basis, except for pink CUs. If spawning location data sources did not differentiate between even-year or odd-year pink, we attributed that spawning location to both even-year and odd-year pink CUs in that area (where applicable). For lake-type sockeye, CU boundaries tend to be constrained to a rearing lake, so to capture the side channels where salmon spawn, we used the rearing lake zone of influence to locate spawning areas. Where sockeye spawning locations were situated outside the lake-type sockeye spawning zone of influence, those spawning locations were assigned to the river-type sockeye CU whose boundary they were located within.

4.2.4 Overview of Habitat Pressure Indicators

Once we have identified salmon habitat and ZOIs, we use a set of habitat pressure indicators to derive coarse-scale assessments of pressures on salmon freshwater habitats. The 12 individual habitat pressure indicators that we use allow us to quantify the potential risks to salmon spawning habitat within each Region and CU (Table 11).

Table 11. Habitat indicator definitions and their relevance to salmon habitat. (Note that watershed refers to the Province of British Columbia's 1:20,000 Freshwater Atlas (FWA) Assessment Watersheds.)

Impact Category	Indicator	Metric	Definition	Relevance
Human Development Footprint	Total Land Cover Alteration	% watershed area	The percentage of the total watershed area that has been altered by human activity.	Total land cover alteration is a synthesis of the indicators for forest disturbance, urban land use, agriculture/rural land use, mining development, and other smaller developments. This indicator represents a suite of potential changes to hydrological processes and sedimentation, with potential impacts on salmon habitats.
	Mining Development	# of mines	The number of active and past-producing coal, mineral, or aggregate (gravel) mine sites within a watershed.	The footprint of a mine and mining processes can change geomorphology and the hydrological processes of water bodies nearby. Mining can contribute to the deposition of fine sediments, which can affect salmon prey densities and salmon survival.
	Impervious Surfaces	% watershed area	The percentage of the total watershed area that is represented by hard, impervious surfaces (e.g. paved)	Extensive impervious surfaces in a watershed can alter and affect natural hydrologic flow patterns and lead to stream degradation through changes in geomorphology and hydrology. They can also lead to increased nutrient loading and contaminant loads downstream.
	Linear Development	km/km^2	The density of all linear developments within a watershed, including roads, railways, utility corridors, pipelines, power lines, telecom cables, right of ways, etc.	Linear development gives an indication of the overall level of development from resource activities that may affect salmon habitats.
Hydrologic Processes	Forest Disturbance	% watershed area	The percentage of total watershed area that has been disturbed by logging and burning in the last 60 years.	Logging and other disturbances that reduce forest cover can change watershed hydrology by affecting rainfall interception, transpiration, and snowmelt processes. Changes over time can affect salmon habitats through altered peak flows, low flows, and annual water yields.

Impact Category	Indicator	Metric	Definition	Relevance
	Equivalent Clearcut Area (ECA)	% watershed area	The percentage of total watershed area that is considered functionally and hydrologically comparable to a clearcut forest. Landscapes that have been altered by urban, road, rail, and forestry development, as well as crown tenure, were considered.	ECA reflects the pressure on salmon habitat mainly from potential increases in peak flow.
Vegetation Quality	Riparian Disturbance	% watershed area	The percentage of the riparian zone, defined as a 30m buffer around all streams, lakes, and wetlands, that have been altered by human activity in each watershed.	Disturbance to riparian areas can affect salmon habitats by destabilizing stream banks, increasing surface erosion and sedimentation, reducing nutrient and woody debris inputs to water bodies, and increasing stream temperatures if streamside shading is diminished.
	Insect and Disease Defoliation	% watershed area	The percentage of pine forests that have been killed by insects or disease in each watershed.	Forest defoliation from insects or disease can reduce precipitation interception, reduce transpiration, and lead to increased soil moisture. The resulting changes to peak flows and groundwater supplies can affect salmon habitats.
Surface Erosion	Road Development	km/km^2	The average density of all roads within a watershed	Road development can interrupt subsurface flow, increase peak flows, and interfere with natural patterns of overland water flow in a watershed. Roads are a significant cause of increased erosion and fine sediment generation, which can impact downstream spawning and rearing habitats.
Fish Passage / Habitat Connectivity	Stream Crossing Density	#/km	The total number of stream crossings per km of the total length of modeled salmon habitat in a watershed.	Stream crossings can create problems for fish passage by interfering with or blocking access to upstream spawning or rearing habitats, thus decreasing the total amount of available salmon habitat. Stream crossings can also affect water delivery to the stream network, causing increased peak flows and become a source of fine sediment delivery to streams.
Water Quantity	Water Licenses	# of permitted water licenses	The total number of water licenses permitted for water withdrawal for domestic, industrial, agricultural, power, and storage uses from points of diversion within a watershed.	Heavy allocation and use of both surface and subsurface water for human use can affect salmon habitat by reducing instream flows to levels that could, at critical times of the year, limit physical access to spawning and rearing habitats or potentially expose redds. Reductions in both surface and subsurface water supply can also lead to increased water temperatures, which can impact salmon at all life stages.

Impact Category	Indicator	Metric	Definition	Relevance
Water Quality	Waste Water Discharges	# of permitted waste water discharges	The number of permitted waste water management discharge sites within a watershed.	Waste water discharge from municipal and industrial sources can impact water quality in salmon habitats through either chemical contamination, which can directly injure or kill aquatic life, or excessive nutrient enrichment (eutrophication), which can result in dissolved oxygen depletion in water bodies and suffocate aquatic organisms.

We developed this set of habitat pressure indicators during our initial methodology development with the Skeena Technical Advisory Committee (Porter et al., 2013a; Porter et al., 2014), building off the recommendations for monitoring and evaluation of salmon habitats under the Wild Salmon Policy (Stalberg et al., 2009), and incorporating additional pressure indicators proposed by Nelitz et al. (2007). Some of these same indicators have been used in other habitat assessment work in the Fraser River watershed (Nelitz et al., 2011) and on the west coast of Vancouver Island (e.g. Smith & Wright, 2016; Wright et al., 2011).

We use specific inclusion criteria to select the datasets we use to inform these habitat pressure indicators to ensure that our methodologies are standardized across Regions. The data that we include must be:

- Publicly available and readily accessible;
- Created with consistent and documented data collection protocols;
- Formatted to allow easy integration into our existing data systems;
- Cost-effective for long-term data collection;
- Reflective of both short- and long-term responses and trends in a given indicator;
- Appropriate to the geographic scale of analysis;
- Supported by quality assurance/quality control protocols and an established data update process.

All of the data we use to inform the 12 habitat pressure indicators are sourced from publicly available provincial or federal agency databases. Most indicator data are sourced from DataBC. Additional datasets are sourced from the BC Ministry of Environment and Climate Change Strategy, BC Ministry of Forests, Lands, Natural Resource Operations and Rural Development (FLNRORD), BC Ministry of Energy, Mines and Low Carbon Innovation, as well as Natural Resources Canada. The publication year for indicator datasets is between 1992 and 2021 (see Appendix 6 for detailed descriptions and limitations, Appendix 7 for a complete listing of datasets, publication years, and data sources).

We quantify each indicator at the scale of the 1:20,000 FWA assessment watersheds based on the specific units of each indicator using ArcGIS Desktop 10.8.1 and a python-scripted ArcGIS Model Builder toolbox. Data processing generally follows a process of selecting features of interest from each indicator dataset and intersecting those with FWA watersheds to quantify habitat pressures by watershed (see Appendix 8 for a complete description of processing methods for each indicator).

4.2.5 Habitat Pressure Indicator Benchmarks

Similar to the biological status assessments, we quantify benchmarks for each indicator to assess habitat status. Using benchmarks allows us to categorize the risk of habitat degradation as low, moderate, or high (green, amber, or red status zones, respectively). When available, we use empirical benchmarks for habitat pressure indicators based on published literature (e.g. Stalberg et al., 2009). When empirical benchmarks are not available, we develop benchmarks based on relative distribution curves for each indicator across the full spatial extent of individual Regions on the Pacific Salmon Explorer (i.e. Fraser Region, Skeena Region, etc.; Table 12). While this approach is consistent with the recommendations of Stalberg et al. (2009), it is considered an interim approach until empirical or expert-based benchmarks become available.

Table 12. Benchmark types for individual habitat pressure indicators.

Impact Category	Indicator	Metric	Benchmark Type	Benchmark Reference
Human Development Footprint	Total Land Cover Alteration	% watershed area	relative ranking (type 2)	n/a
	Mining Development	# of mines	relative ranking (type 2, binary)	n/a
	Impervious Surfaces	% watershed area	science-based and expert-based	Paul & Meyer, 2001; Smith, 2005
	Linear Development	km/km^2	relative ranking (see Appendix 12)	n/a
Hydrologic Processes	Forest Disturbance	% watershed area	relative ranking (type 2)	n/a

Impact Category	Indicator	Metric	Benchmark Type	Benchmark Reference
	Equivalent Clearcut Area (ECA)	% watershed area	green/amber – science-based and expert-based; amber/red – science-based	green/amber – NOAA, 1996; MOF, 2001; amber/red – Summit/MOE, 2006; FPB, 2011
Vegetation Quality	Riparian Disturbance	% watershed area	green/amber – science-based and expert-based; amber/red – science-based	green/amber – Stalberg et al., 2009; amber/red – Tripp & Bird, 2004
	Insect and Disease Defoliation	% watershed area	relative ranking (see Appendix 12)	n/a
Surface Erosion	Road Development	km/km^2	green/amber – science-based and expert-based; amber/red – science-based	green/amber – Stalberg et al., 2009; amber/red – MOF, 1995a,b; Porter et al., 2012
Fish Passage/Habitat Connectivity	Stream Crossing Density	#/km	relative ranking (see Appendix 12)	n/a
Water Quantity	Water Licenses	# of permitted water licenses	relative ranking (type 2, binary)	n/a
Water Quality	Waste Water Discharges	# of permitted waste water discharges	relative ranking (type 2, binary)	n/a

We use two approaches for developing relative benchmarks, depending on the distribution of the indicator data. These approaches were developed during our initial work on habitat pressure indicators with the Skeena Technical Advisory Committee (Porter et al., 2013a; Porter et al., 2014) and were later refined to address indicators with highly skewed distributions (Porter et al., 2016).

Type 1: Indicator values have symmetric or moderately skewed distributions

We take this approach if habitat indicators have a symmetric or moderately skewed distribution. Using the distribution of indicator values across all Freshwater Atlas (FWA) assessment watersheds, we set the lower benchmark at the 50th percentile and the upper benchmark at the 75th percentile. This means that the "best" 50% of watersheds are considered low risk (green), the "worst" 25% of watersheds are considered high risk (red), and all other watersheds are considered at moderate risk (amber) for that pressure indicator.

Type 2: Indicator values have a highly skewed distribution

If habitat indicators have a highly skewed distribution, we set the lower benchmark at 0 and the upper benchmark at the statistical threshold for outlier values. Using this approach, watersheds with a 0 value are considered low risk (green), watersheds with outlier values are considered high risk (red), and all other watersheds are considered moderate risk (amber) for that pressure indicator.

In some cases, the indicator values may be so highly skewed that the outlier threshold is zero. In these cases, we apply a binary approach where watersheds with a 0 value are considered low risk (green, absence), and watersheds with a value above zero are considered high risk (red, presence). This binary approach applies to the Mining Development, Water Licenses, and Waste Water Discharges indicators (Table 12). See Section 4.2.8: Limitations for further discussion of relative benchmark rankings.

4.2.6 Approach to Assessing Cumulative Habitat Pressures

Pressures on salmon freshwater habitats have both an individual and potential cumulative impact. We develop cumulative pressure scores for each FWA assessment watershed across CUs and Regions in the Pacific Salmon Explorer to reflect these interactions and understand the risk of habitat degradation posed by cumulative pressures. This approach allows us to visualize which CUs face the greatest potential cumulative risks to habitat conditions based on the set of pressure indicators that we assess. Cumulative scores are useful for providing a baseline to consider future risks and identify priority areas to avoid further impacts. A cumulative pressure score also provides a summary index to consider pressures on salmon habitat in relation to the biological status of CUs. This information can help in prioritizing conservation efforts, mitigation strategies, and identifying areas for monitoring state indicators at a higher resolution.

Aggregating indicators into a single, composite risk or condition score is an approach taken by a variety of programs that currently monitor watersheds in Canada and the U.S. Pacific Northwest (e.g. FLNRORD's Forest and Range Evaluation Program, USEPA's Environmental Monitoring and Assessment Program, USDA Forest Service's Aquatic and Riparian Effectiveness Monitoring Program). These programs use a variety of methods to aggregate their habitat data, and each approach has strengths and weaknesses (Pickard et al., 2008). Habitat indicator analyses for BC salmon CUs (e.g. Cohen Commission analyses of Fraser sockeye CUs (Nelitz et al., 2011) and an indicator-mapping project for the Lower Thompson coho CU (Beauchamp, 2008) generated cumulative habitat stressor or impact scores based on a simple summation of all the individually scored indicators (i.e. a higher total score equates to higher risk). Habitat assessments for southern BC Chinook CUs (Porter et al., 2013b) employed an alternative approach for rating relative risk in watersheds whereby cumulative risk scoring was based on an indicator 'roll-up' rule set based on the proportion of the indicators that were rated low, moderate, or high risk.

For the habitat pressure assessments included in the Pacific Salmon Explorer, we apply a set of roll-up rules to assign cumulative pressure scores (see Appendix 11). We calculate this cumulative pressure score for individual 1:20,000 FWA assessment watersheds within the zones of influence of all CUs. Any Region-specific idiosyncrasies are documented within Section 5: Regions: Specific Data, Methods, and Results.

4.2.7 Future Resource Development Pressures

In addition to assessing risks to freshwater salmon habitats based on 12 pressure indicators, we also compile data and map information on proposed resource development projects that represent potential additional risks to salmon and their freshwater habitats. These 'future pressures' are not quantitatively integrated into the habitat pressure assessments; however, we do map data on proposed resource development projects alongside current development projects in recognition of the potential impacts these activities may have on freshwater salmon habitats and to allow for the consideration of habitat status in the siting and planning of proposed development projects.

Specifically, activities related to the construction and operation of industrial infrastructure can affect the physical and chemical nature of streams, rivers, and upland habitat and potentially lead to degradation, fragmentation, and loss of spawning, rearing, and migration habitats (Natural Research Council, 1996). Salmon are sensitive to changes in stream temperature, flow, turbidity, dissolved oxygen levels, and water contamination. As well, salmon are dependent on the habitat complexity (for cover and temperature moderation) provided by naturally vegetated banks and, therefore may be affected by degradation or alteration of shorelines and stream banks.

For each Region, we compile data on seven categories of proposed (and current) resource development pressures:

- Oil and gas pipelines
- Mining development
- Water licenses
- Hydroelectric power tenures
- Hydroelectric power lines
- Wind power tenures
- Timber harvesting land base

For additional processing details, see Appendix 9. In some Regions, we are also able to document additional infrastructure; this is detailed in Section 5: Regions: Specific Data, Methods, and Results.

4.2.8 Limitations: Habitat pressure indicators & analysis methods

While the current suite of indicators has been developed according to Wild Salmon Policy guidelines (Stalberg et al., 2009), they do not reflect all of the pressures on wild salmon. Understanding the full range of pressures on salmon requires documenting marine habitat pressures, climate change indicators, and a deeper understanding of fisheries pressure, to name a few. Given the set of habitat pressure indicators that we currently include on the Pacific Salmon Explorer, specific limitations of our approach relate to outdated and incomplete datasets, benchmark methodologies, and methods for calculating cumulative pressure scores. These limitations apply to all Regions, species, and CUs that we include in the Pacific Salmon Explorer and should be considered as both caveats to the current habitat assessment results as well as future research priorities.

A: Data Needs

Incomplete and outdated datasets are a continued challenge for completing coarse-scale assessments of risks to freshwater habitats. For example, the Total Land Cover Alteration indicator uses land cover classification data between 1996-2005 and the National Topographic system dataset from 1998. This is an example of where more current datasets certainly exist but are either not yet publicly available or may not conform to our data selection criteria.

Throughout the Regions in BC, some areas contain privately managed forest land. As such, forest disturbance data sourced from DataBC in these areas is either incomplete or not up to date. We defined a 'Data Deficient' status for the forest disturbance indicator to overcome this challenge. The data deficient status was assigned for any watershed that was >= 50% privately owned forest. The exception was that high-risk status was maintained and reported if a watershed was high risk for forest disturbance based on the publicly available forest disturbance data.

Overall, temporal and spatial data gaps limit our ability to quantify and assess current freshwater salmon habitat risks accurately. Better and more currently maintained spatial data are needed to support a more accurate and up-to-date assessment of pressures on freshwater salmon habitats across all Regions (see Appendix 6 for dataset limitations).

B: Refining Benchmarks

Additional research is needed to define science-based benchmarks for some pressure indicators. In the interim, we use benchmarks based on relative rankings within each Region (Table 12; see Appendix 12 for specific benchmark values for each Region). While acceptable as an interim approach (Stalberg et al., 2009), this presents data interpretation challenges and limits our ability to compare habitat assessments across Regions for those indicators. Until empirical or science-based benchmarks are available, it is important to consider the relative nature of the habitat assessments for these indicators when interpreting the results.

C: Cumulative Pressure Scores

The approach we use to calculate overall cumulative pressure scores for freshwater salmon habitats is a roll-up rule set described in Appendix 11. Using this approach means that each indicator is weighted equally in terms of the overall cumulative pressure score. We do not weight certain indicators as having more or less impact on salmon habitat over others. Determining how best to aggregate indicators to calculate overall cumulative pressure scores is a challenge, and while this approach is transparent and easily understood by a range of audiences, it is certainly not the only way to aggregate indicators, nor necessarily the best way.

4.3 Reporting Biological and Habitat Status Across Spatial Scales

In addition to providing biological and habitat information for individual salmon CUs, we also provide information on the status and trends of salmon populations and their habitats at the **Stock Management Unit (SMU)**, **regional**, and **provincial scales** to improve understanding of the current state of salmon at different geographic scales. While finer-scale data such as CUs are important for supporting the implementation of Canada's Wild Salmon Policy, coarser-scale synoptic overviews of salmon population status and trends across species and regions are also important for salmon conservation and management. These multi-scale overviews help to improve understanding of patterns in trends and status of salmon CUs across or within regions of BC and offer insights into potential habitat pressures that could be driving changes in salmon populations. They can also inform regional, provincial, and federal planning and decision-making.

4.3.1 Stock Management Units

In order to increase the utility of the Pacific Salmon Explorer as a reporting tool for DFO and others under the new Fisheries Act, CUs can be grouped and sorted by **Stock Management Unit (SMU)**, based on the provisional list provided by DFO. We are also currently working with DFO to incorporate SMUs into the Pacific Salmon Explorer in additional ways.

4.3.2 Regional Summaries

Biological information is summarized at the **regional scale** to provide a measure of how the total number of returning adult salmon has changed over time for each species within each Region on the Pacific Salmon Explorer. We determine (1) the total run size (catch + spawner abundance) for each individual CU and; (2) the total salmon run size for all CUs combined within a given species. In the Pacific Salmon Explorer, we display the total run size for each CU within each species in a single Region, along with the same total run size data standardized so that larger CUs do not dominate the summaries. In both cases, we also display the overall trend for each species.

Habitat information is also summarized at the **regional scale** for each Region in the Pacific Salmon Explorer by providing a comparison of the 12 habitat pressure indicators. In the Pacific Salmon Explorer, for each indicator, we display the percentage of FWA watersheds within the combined ZOI for all CUs within a species that are rated low, moderate, and high risk. The indicators are then ranked from high to low relative to the percentage of high-risk FWA watersheds assessed for a given indicator. This summary provides a snapshot of how the pressure indicators rank compared to one another and which pressures included in the Pacific Salmon Explorer pose the greatest risk to freshwater salmon habitats within a Region.

4.3.3 Provincial Summaries

On the Pacific Salmon Explorer, we provide an overview of the status and trends of salmon CUs at the **BC scale** based on two indicators, run size and biological status. Trends in run size provide a measure of how the total number of returning adult salmon has changed over time for each species. We display (1) the total run size (catch + spawner abundance) over time by species in each Region, (2) the standardized run size (catch + spawner abundance) over time by species in each Region, and (3) the percent change between the most recent decade relative to the long-term average. We also summarize the current biological status for each salmon species across BC and a visual comparison of biological status across regions via maps. This summary provides a snapshot of the current biological status by species by quantifying the proportion of CUs within a species in the green, amber, and red status zones. It also shows *where* these CUs are located.

We do not currently visualize habitat summary statistics at the BC scale. Differences in the way habitat benchmarks are quantified (e.g. relative vs. science-based benchmarks; Section 4.2.5. Habitat Pressure Indicator Benchmarks) present challenges in making provincial comparisons of habitat status. Through future work with the Habitat Science Advisory Committee, we hope to develop BC-scale habitat summaries.

5.0 Regions: Specific Data, Methods, and Results

Each **Region** within the Pacific Salmon Explorer has specific attributes related to management regimes, data collection, documentation protocols, and most importantly, salmon populations and habitats. Here, we document Region-specific data sources, methodological considerations, and social processes used in each of the initial biological status, habitat pressure assessments, and any other unique information for each region currently within the Pacific Salmon Explorer.

5.1 Skeena Region

The Skeena River watershed, located along the north coast of BC, is the second-largest in the province, contains important tributaries, including the Babine, Kispiox, and Bulkley Rivers, and is one of the most productive river systems in BC. All five species of Pacific salmon spawn and rear in the lower and upper portions of the Skeena River Basin (Figure 5) within 55 CUs: 12-Chinook, 4-coho, 4-chum, 5-pink, 2-river-type sockeye, and 28-lake-type sockeye (Appendix 1). The process of data gathering, synthesis, outreach, and engagement to complete the initial assessments within the Skeena Region was conducted over five years, from 2010 to 2014.

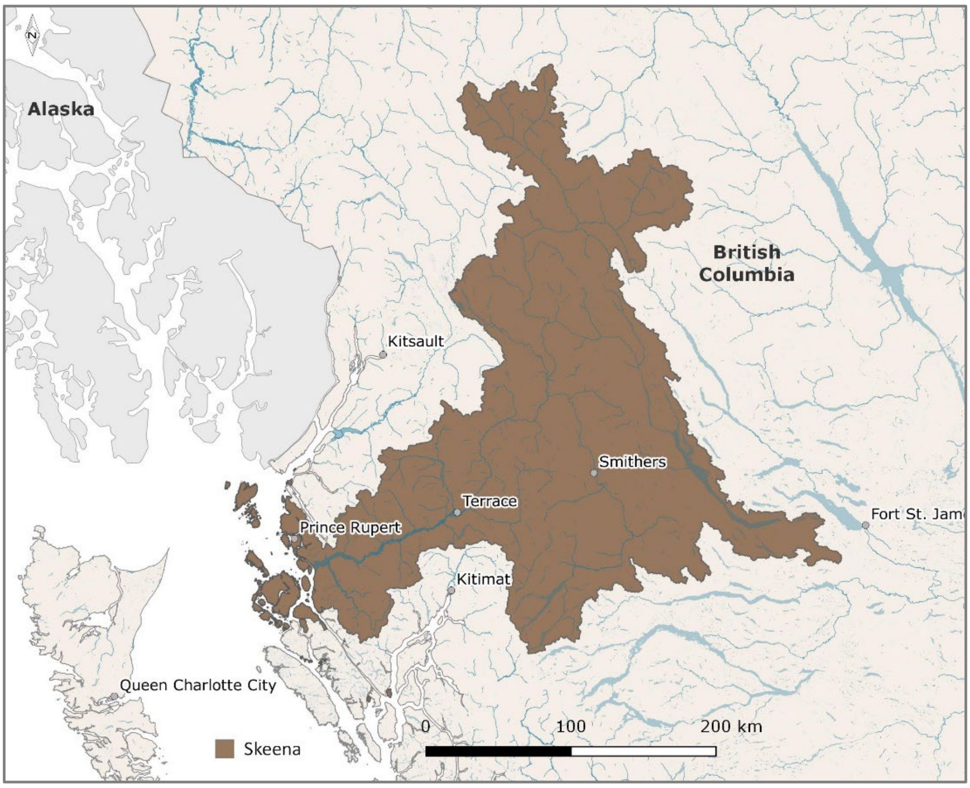

Figure 5. Map of the Skeena Region.

In order to develop the Pacific Salmon Explorer for the Skeena, we formed a Skeena Technical Advisory Committee and engaged with First Nations, DFO, and other salmon experts throughout the watershed. Through the Technical Advisory Committee process, we received input and feedback from the Gitanyow Fisheries Authority, DFO, Office of the Wet’suwet’en, Lake Babine Nation, Gitxsan Watershed Authorities, Gitxaala First Nation, North Coast-Skeena First Nations Stewardship Society, SkeenaWild Conservation Trust, Bulkley Valley Research Centre, Suskwa Research, BC Ministry of Environment, and DFO.

Based on feedback from the Skeena Technical Advisory Committee, we made several changes to the CU list in this project. The Mcdonnell, Aldrich, and Dennis lake-type sockeye CUs were combined into a single CU (Mcdonnell/Aldrich/Dennis) since the contribution of each of these lakes cannot be currently assessed from the estimated spawner abundance data. Similarly, the Morice and Atna lake-type sockeye CUs were combined (Morice/Atna), the Swan and Club Lake lake-type sockeye CUs were combined (Swan/Club), and the Bulkley and Maxan (Bulkley/Maxan) lake-type sockeye CUs were combined for the same reason. The Babine lake-type sockeye CU was split into four CUs based on run-timing and enhancement. The wild portions of the CU were split into Babine/Onerka (early timing), Tahlo/Morrison (mid timing), and Nilkitkwa (late timing). The enhanced portion of the CU (originating from the Pinkut and Fulton spawning channels) is considered as the Babine (enhanced) CU.

5.3.1 Biological Data and Analytical Methods

On the North and Central Coast, including the Skeena Region, PSF primarily accessed data through the North and Central Coast (NCC) Database (English et al., 2018). The NCC Database is a database produced and maintained by LGL Ltd. (an environmental consulting firm) that synthesizes datasets on spawner surveys, catch, exploitation rate, and age structure. It also includes generated datasets for CU-level estimates of spawner abundance, run size, and exploitation rate from 1954- 2017. For the most part, data in the NCC Database have been sourced by LGL from DFO’s New Salmon Escapement Database (NuSEDS), the Fisheries Operating System (FOS), and other DFO databases. Details regarding nuances to the data and analytical methods specific to the Skeena Region are described below.

A: Spawner Surveys

Spawner survey data for streams in the Skeena Region were sourced from DFO’s New Salmon Escapement Database (NuSEDS). For a description of the spawner survey indicator, see Section 4.1.1. Overview of Biological Indicators, A: Spawner Surveys.

B: Spawner Abundance

Observed spawner abundance for CUs in the Skeena Region is the sum of all spawner survey data documented in NuSEDS, as described in Section 4.1.1. Overview of Biological Indicators, B: Spawner Abundance.

The quantity and quality of the **estimated spawner abundance** in NuSEDS varies by time period, region, and stream. Meanwhile, the observed spawner abundance data are not always representative of actual changes in abundance through time for a CU. As such, an "expansion procedure" is needed so that any changes in abundance through time are not confounded with changes in monitoring effort. Since 2008, PSF has worked with LGL Limited to generate Skeena (and Nass and Central Coast) CU-level estimated spawner abundance or run reconstructions in collaboration with DFO North Coast stock assessment staff (English et al., 2006; English, 2012; English et al., 2018). Three expansion factors are used to generate estimated spawner abundance. The first expansion factor uses historical proportional contribution data to infill indicator streams not monitored in a given year. The second expansion factor expands the data from the monitored indicator streams so that the estimated spawner abundance is representative of the entire CU. The final expansion factor expands this number again for observer efficiency. Skeena CU-level estimates of spawner abundance (run reconstructions) were sourced from the North and Central Coast (NCC) database.

The expansion procedures, by necessity, make a number of simplifying assumptions. The first expansion factor assumes that the proportion of the overall CU that each indicator stream represents is constant through time. The second expansion factor assumes that indicator and non-indicator streams make up a constant contribution to the overall abundance of a CU. The final expansion factor assumes that observer efficiency is constant between years, CUs, methodologies (except for fences), and hydrological systems (see Appendix E in English et al., 2016). For CUs in the Skeena Region (and for CUs in the Nass and Central Coast Regions). We attempted to account for potential data quality issues associated with the final observer efficiency expansion factor (see Section 4.1.3: Data Quality). However, these assumptions may potentially still incorporate uncertainty into our assessments of biological status in these Region's CUs. These uncertainties result from spawner surveys being conducted using various methodologies and/or by different observers throughout time, which is not currently accounted for.

For Skeena Chinook, the methods used to derive spawner abundance estimates for Chinook indicator streams (e.g. Kalum, Morice, and Bear) and coverage of Chinook spawning areas improved in the mid-1980s with additional funding provided through the Pacific Salmon Treaty. For most Skeena Chinook indicator streams, there is no basis for defining observer efficiencies before 1985, so these records were not included in the generation of estimated spawner abundance. This means that estimated spawner abundance and catch and run size for Skeena Chinook CUs begin in 1980.

In contrast to Chinook, there has been more consistent distribution and quantity of monitoring effort for Skeena sockeye CUs dating back to 1960. For Skeena sockeye CUs, the spawner abundance time series starts in 1960 because this was the first year of pre-1982 run reconstruction analysis (Les Jantz, DFO, pers. comm.). The fact that a large portion of Skeena sockeye have been enumerated at the Babine fence since 1949 provides greater confidence in the annual escapement estimates for sockeye than for Skeena Chinook in the 1960-1984 period.

C: Run Timing

Estimates of **peak timing of river entry** for the different sockeye CUs were estimated from DNA sampled from fish caught in the Tyee test fishery near the mouth of the Skeena River between 2000-2010 (Cox-Rogers, 2012). The duration of the timing of river entry is assumed to have a bell-shaped curve (i.e. normal distribution), so the shape of the curves is defined by the mean and standard deviation of the available run timing data. However, in most instances, there is insufficient data to determine if a different distribution would better describe the shape of the curve. A normal distribution curve is likely a reasonable approximation for run timing in most cases if the run timing is unimodal (i.e. if there is a single peak in run timing). If the run timing is bi-modal (i.e. if there are two run timing groups), the assumption of spread is likely reasonable, but the peak may be misleading.

Note that these run timing curves were only used to estimate exploitation rates for Skeena sockeye CUs. A conservative assumption of relatively broad run timing (80-110 days) for each sockeye CU was used so that exploitation rates would not be sensitive to small shifts in fishery timing. For some CUs, run timing information is not available, and for some species, run timing is assumed to be the same for all CUs. Run timing for other species was estimated by DFO North Coast staff. See Section 4.1.1. Overview of Biological Indicators, C: Run Timing for a description of the run timing indicator and methods.

D: Catch & Run Size

Catch and run size, and subsequent exploitation rates for CUs in the Skeena region were calculated by LGL and DFO from the Fisheries Operating System (FOS) and other DFO databases. We accessed these datasets via the North and Central Coast (NCC) Database, maintained by LGL Ltd. (English et al., 2018). For a description of catch and run size methods, see Section 4.1.1. Overview of Biological Indicators, D: Catch & Run Size.

E: Recruits-per-Spawner

Recruits-per-spawner data for CUs in the Skeena Region were derived from the DFO age database and CU-level estimates of spawner abundance and catch and run size, accessed from the NCC Database (English et al., 2018). For a description of recruits-per-spawner methods, see Section 4.1.1. Overview of Biological Indicators, *E: Recruits-per-Spawner*.

F: Trends in Spawner Abundance

Trends in spawner abundance for CUs in the Skeena Region were derived from the CU-level estimates of spawner abundance accessed from the NCC Database (English et al., 2018). For a description of trends in spawner abundance methods, see Section 4.1.1. Overview of Biological Indicators, F: Trends in Spawner Abundance.

G: Juvenile Surveys

Juvenile abundance data for the Babine (enhanced), Babine/Onerka, Tahlo/Morrison, and Nilkitkwa lake-type sockeye CUs were available in Cox-Rogers and Splisted (2012). Juvenile abundance estimates for the Gitanyow lake-type sockeye CU were available from Beblow and Cleveland (2018). Juvenile abundance of the Slamgeesh lake-type sockeye CU was available from Fernando (2012). For a description of the juvenile survey's indicator, see Section 4.1.1. Overview of Biological Indicators, G: Juvenile Surveys.

H: Hatchery Releases

Hatchery releases in the Skeena Region for all species were provided by DFO (Joan Bateman, Salmonid Enhancement Program). Refer to Section 4.1.1. Overview of Biological Indicators, H: Hatchery Releases for details on data and analytical methods.

I: Biological Status

The **biological status** assessments for CUs in the Skeena Region reflect data sourced from the NCC database and are current up to 2017. The original approach and results for Skeena biological status assessments are described in Korman and English (2013). As new data become available, we will update the analyses and results in this report and the Pacific Salmon Explorer. See Sections 4.1.4. Benchmarks for Assessing Biological Status and 4.1.5. Decision Rules for Assessing Biological Status for more details on biological status assessment methods.

5.1.2 Habitat Data and Analytical Methods

Nuances regarding habitat pressure indicator data and analytical methods for the Skeena Region are listed below. Refer to Section 4.2. Indicators and Benchmarks for Assessing Habitat Status for information on habitat pressure indicators, benchmarks, and the analytical methods used to assess habitat status. Additional details on habitat pressure indicators, data sources, data currency, and benchmarks specific to the Skeena Region are available in Appendix 6 (Description of Habitat Pressure Indicators & Relevance to Salmon), Appendix 7 (Habitat Pressure Datasets & Data Sources), Appendix 8 (Spatial Data Processing for Habitat Pressure Indicators), Appendix 9 (Spatial Data Processing for Future Pressures), Appendix 12 (Habitat Pressure Benchmark Values by Region).

A: Transboundary Conservation Units

The pink (even-year) Nass-Skeena Estuary CU spans the boundary between the Skeena and Nass regions. For habitat indicators that used relative benchmarks, habitat status for this transboundary CU was assessed based on benchmarks derived from the Skeena region because a significant portion of this CU's spawning habitat fell inside the Skeena region.

B: Spawning Zones of Influence

Methods for delineating Chinook CU **spawning zones of influence (ZOIs)** vary by region in accordance with the CU delineation approach used by DFO. In the Skeena, Nass, and Central Coast regions, Chinook CUs are defined using a more restrictive geographic representation, which resulted in fewer (or no) spawning locations occurring within the CU boundaries. As such, spawning ZOIs for each Chinook CU were delineated using the extent of all 1:20K FWA Assessment Watersheds that directly intersected with Skeena Chinook CU boundaries.

5.1.3 Results

A: Biological Status

This section provides a high-level overview of the biological status results for all 55 salmon CUs in the Skeena Region. Of the 55 CUs we examined in the Region, we assessed biological status for 31 CUs (56%). The remaining 24 salmon CUs (44%) had insufficient information for evaluating their biological status (see Section 4.1.5. Decision Rules for Assessing Biological Status for the criteria used to define data deficient CUs). Of the CUs for which we were able to assess biological status, 18 (58%) are in the green status zone, 4 (13%) are in the amber zone, and 9 (29%) are in the red status zone. Biological status for all CUs is displayed by species in Figures 6- 12 below. More information on biological status and benchmarks for each CU is available Table A.6 in Appendix 4. Full results are available online through the Pacific Salmon Explorer, where individual figures, maps, data, and summary statistics are provided for each CU in the Region. The results of these assessments reflect data that are current to 2017. As new data becomes available, we will update the analyses and results in this report and on the Pacific Salmon Explorer.

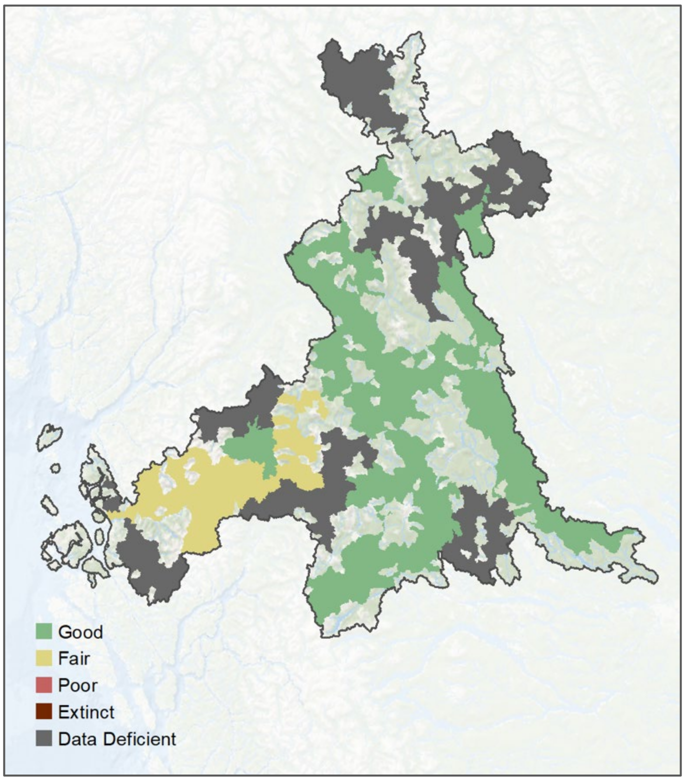

Figure 6. Pacific Salmon Foundation biological status of Skeena Chinook salmon Conservation Units.

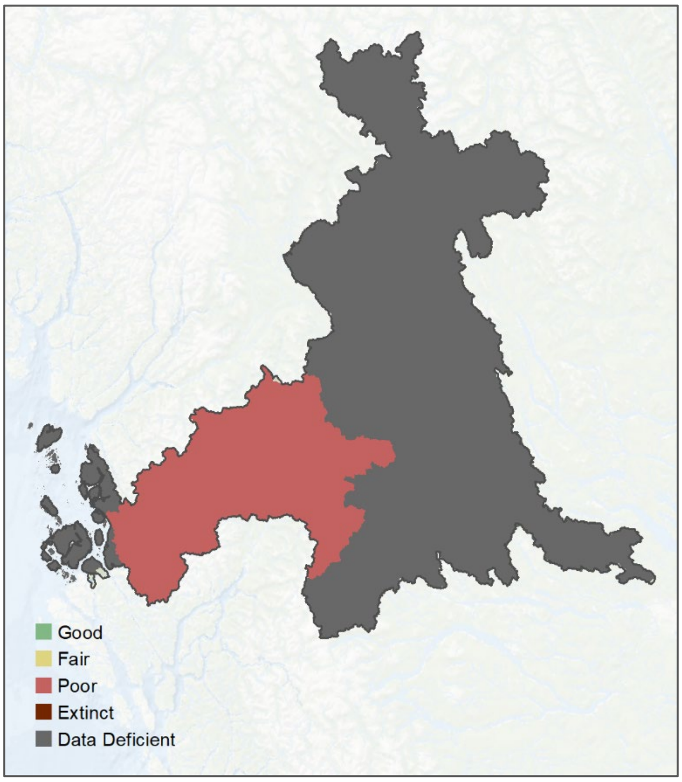

Figure 7. Pacific Salmon Foundation biological status of Skeena chum salmon Conservation Units.

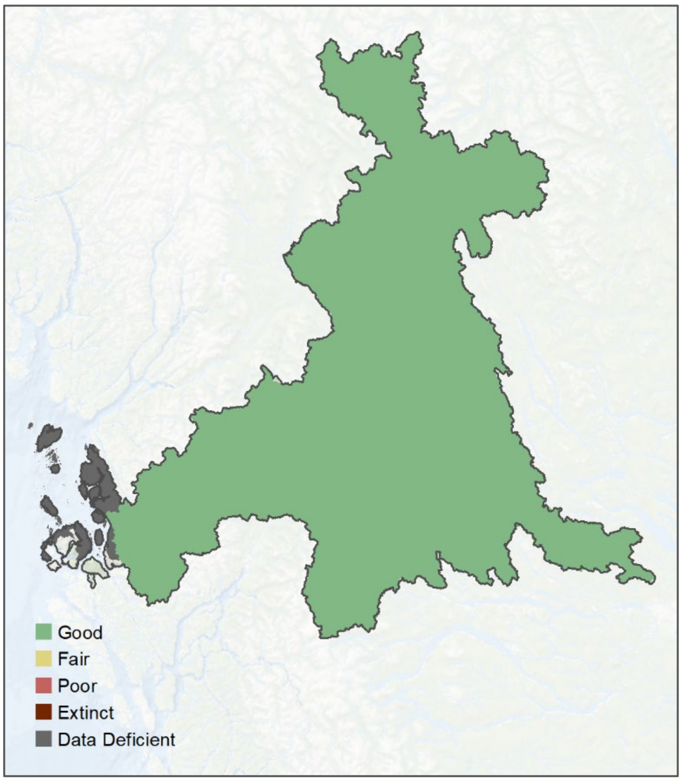

Figure 8. Pacific Salmon Foundation biological status of Skeena coho salmon Conservation Units.

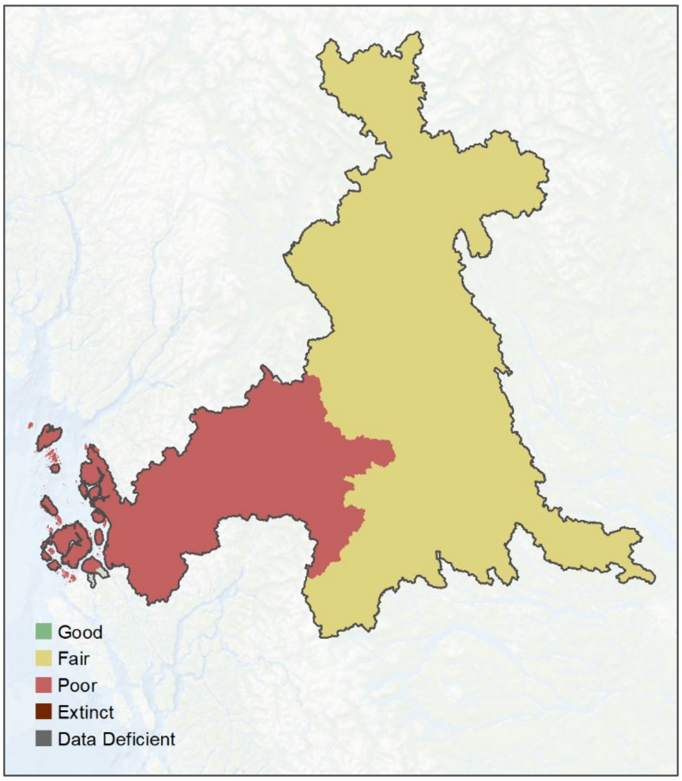

Figure 9. Pacific Salmon Foundation biological status of Skeena pink (odd) salmon Conservation Units.

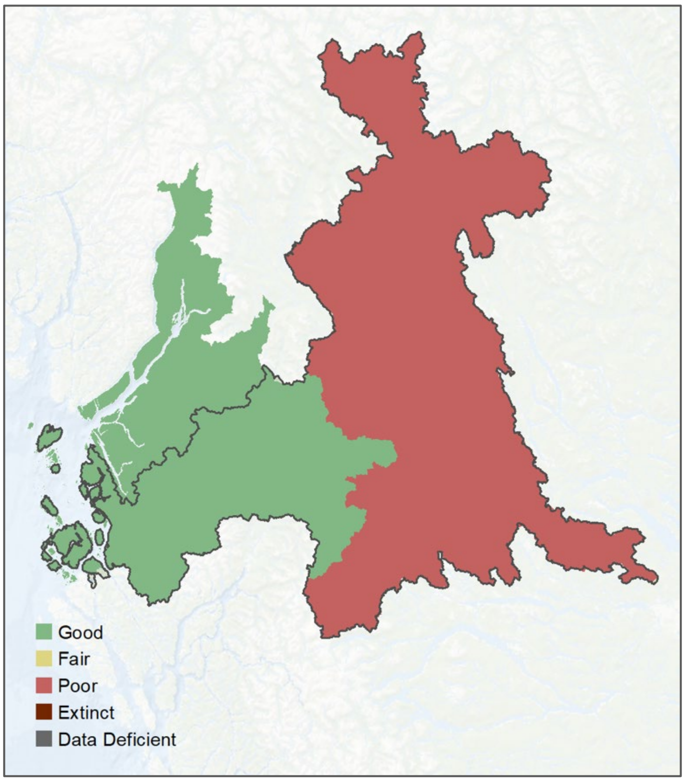

Figure 10. Pacific Salmon Foundation biological status of Skeena pink (even) salmon Conservation Units.

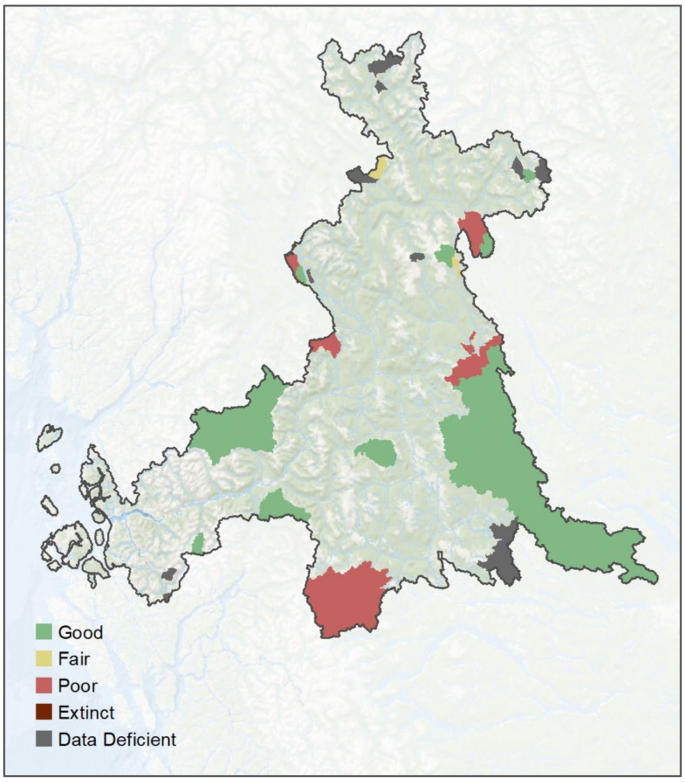

Figure 11. Pacific Salmon Foundation biological status of Skeena sockeye (lake-type) salmon Conservation Units.

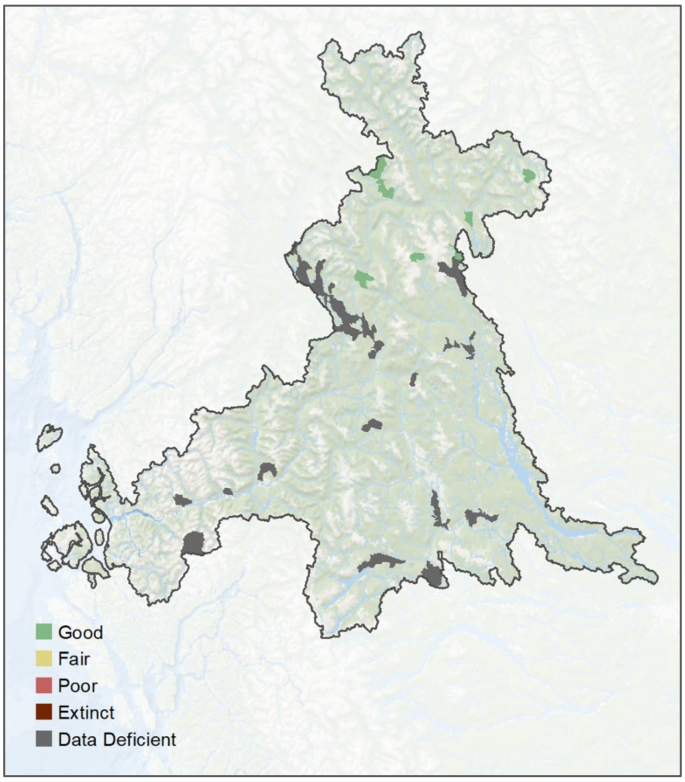

Figure 12. Pacific Salmon Foundation biological status of Skeena sockeye (river-type) salmon Conservation Units.

B: Habitat Status

We completed habitat assessments for watersheds within the 55 salmon CUs in the Skeena Region. The habitat assessments produce two levels of outputs for spawning ZOIs: (1) a risk rating for each FWA assessment watershed in the study area for each individual habitat pressure indicator; (2) a cumulative pressure score for each FWA assessment watershed in the study area, representing the risk to a watershed from all habitat pressures combined. Of the 1,183 1:20K FWA assessment watersheds assessed in the Skeena Region, 80% (n= 941) were designated as spawning habitat based on compiled spawning location data. These 941 watersheds represent the combined spawning ZOI for all species. In terms of the cumulative pressure scores for the combined spawning ZOI for all species, 28% of spawning habitat in the Skeena Region is high risk (red), 33% is moderate risk (amber), and 40% is low risk (green). The percentage of spawning habitat in each risk category for each indicator is summarized in Table 13 below.

Table 13. The percentage of area within the Skeena Region's combined spawning ZOI for all species rated high, moderate, or low risk (i.e. red, amber, green) for cumulative pressures and for each evaluated individual habitat pressure indicator.

Indicator	% Area of Spawning Habitat		
	High Risk	Moderate Risk	Low Risk
Total Landcover Alteration	27%	33%	40%
Forest Disturbance	28%	30%	42%
Impervious Surfaces	0%	2%	98%
Mines	10%	0%	90%
Linear Development	27%	33%	40%
Road Development	24%	30%	47%
Stream Crossing Density	29%	27%	44%
Riparian Disturbance	28%	23%	49%
Water Licenses	16%	0%	84%
Waste Water Discharges	4%	0%	96%
Equivalent Clearcut Area	15%	7%	78%
Insect and Disease Defoliation	33%	24%	44%
Cumulative Pressures	28%	33%	40%

Quantifying both individual and cumulative pressures at the FWA assessment watershed-scale provides a snapshot of habitat pressures across the Skeena Region and highlights which CUs face the greatest risk. Specifically, an overview of habitat pressures emerges from identifying:

1. the percentage area of the combined spawning ZOI for all species that is rated high, moderate, or low risk (i.e. red, amber, green) for each of the evaluated individual habitat pressure indicators; and
2. the percentage area of the combined spawning ZOI for all species that is rated high, moderate, or low risk (i.e. red, amber, green) for cumulative habitat pressures.

More information on habitat pressure benchmark values for each indicator is available in Appendix 12. More information on cumulative spawning Pressure Results by Region and Conservation Unit is available in Appendix 13. Full results are available online through the Pacific Salmon Explorer. The results can be downloaded directly from the Pacific Salmon Explorer for each CU, while the datasets compiled for the analysis are also available for download via the Salmon Data Library.

In addition, the Skeena River estuary was assessed in 2015, and results are available on the Pacific Salmon Explorer. For details on the Skeena estuary, habitat assessment methods, see Pickard et al. (2015).

5.2 Nass Region

In northern BC, the Nass River watershed is the third-largest watershed in the province and includes several major tributaries, including the Bell-Irving, Cranberry, Meziadin, Kwinageese, and Damdochax Rivers. The Nass Region (Figure 13), which consists of the watersheds draining into Portland Canal and Observatory Inlet, contains extensive spawning and rearing habitat for all five species of Pacific salmon, as well as steelhead. These salmon populations are managed as 22 CUs under the Wild Salmon Policy: 2-chinook, 3-chum, 3-coho, 4-pink, and 10-sockeye CUs (Appendix 1). The process of data gathering, synthesis, outreach, and engagement to complete the initial assessments within the Nass Region was conducted over four years, from 2015 to 2019.

We worked with First Nations in the Nass Region to garner feedback on the Pacific Salmon Explorer approach and analyses through the Nisga’a-Canada-BC Nass Joint Technical Committee and the Gitanyow Fisheries Authority. In addition, in 2015-2016, we formed a Nass Technical Advisory Committee to engage with First Nations, DFO regional biologists and managers, and other salmon experts throughout the watershed.

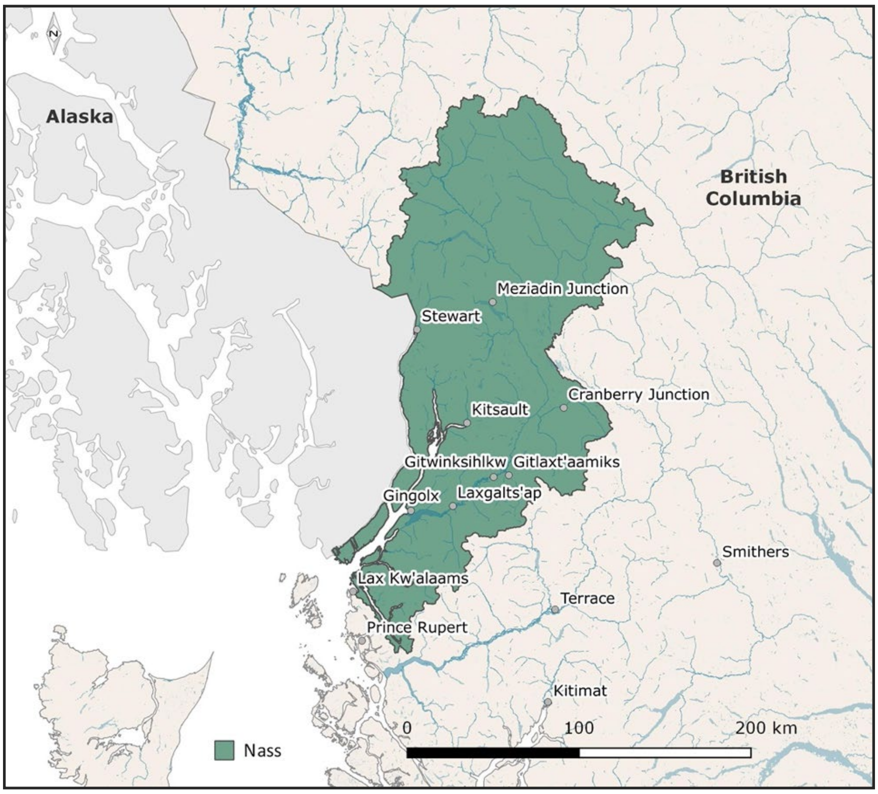

Figure 13. Map of the Nass Region.

5.2.1 Biological Data and Analytical Methods

As with the Skeena Region, many of the datasets necessary to understand the dynamics of salmon CUs in the Nass Region have been compiled and stored through the North and Central Coast (NCC) Database (English et al., 2018; see Skeena Region). In addition to these data, we also compiled additional data for six CUs (Lower Nass and Upper Nass coho; Fred Wright, Damodochax, and Meziadin lake-type sockeye; Lower Nass-Portland river-type sockeye) through a review of preliminary data with Nisga'a Lisims Government and LGL Limited staff. Details regarding nuances to the data and analytical methods that are specific to the Nass Region are described below.

A: Spawner Surveys

Spawner survey data for streams in the Nass Region were sourced from DFO's New Salmon Escapement Database (NuSEDS). For a description of the spawner survey indicator, see Section 4.1.1. Overview of Biological Indicators, A: Spawner Surveys.

B: Spawner Abundance

Observed spawner abundance for CUs in the Nass Region is the sum of all spawner survey data as documented in NuSEDS, as described in Section 4.1.1. Overview of Biological Indicators, B: Spawner Abundance.

Nass Region CU-level **estimates of spawner abundance** (run reconstructions) were sourced from the North and Central Coast (NCC) Database. Nass CU-level estimated spawner abundance time series were developed for the NCC Database according to the expansion factors described in the Skeena Region section above.

In addition, CU-level estimates of spawner abundance for five Nass CUs are derived from additional spawner enumeration methods. Specifically, three CUs have mark-recapture programs operated by Nisga'a Fisheries, and Wildlife's lower Nass River fish wheels have mark-recapture programs. These programs have been part of Nisga'a Treaty fisheries work since 1992.

C: Run Timing

We currently do not have CU-level **run timing** data visualized for any CUs in the Nass Region. See Section 4.1.1. Overview of Biological Indicators, C: Run Timing for a description of the run timing indicator and methods.

D: Catch & Run Size

Catch and run size, and subsequent exploitation rates for CUs in the Nass Region were calculated by LGL, Nisga'a Fish and Wildlife, and DFO from the Fisheries Operating System (FOS) and other DFO databases. Similar to our work in the Skeena, we accessed most of these datasets via the North and Central Coast (NCC) Database, maintained by LGL Ltd. (English et al., 2018). For a description of catch and run size methods, see Section 4.1.1. Overview of Biological Indicators, D: Catch & Run Size.

E: Recruits-per-Spawner

Recruits-per-spawner data for CUs in the Nass Region were derived from the DFO age database and CU-level estimates of spawner abundance and catch and run size accessed from the NCC Database (English et al., 2018). For a description of recruits-per-spawner methods, see Section 4.1.1. Overview of Biological Indicators, E: Recruits-per-Spawner.

F: Trends in Spawner Abundance

Trends in spawner abundance for CUs on the Central Coast were derived from the CU-level estimates of spawner abundance accessed from the NCC database (English et al., 2018). For a description of trends in spawner abundance methods, see Section 4.1.1. Overview of Biological Indicators, F: Trends in Spawner Abundance.

G: Juvenile Surveys

Smolt abundance data for the Lower Nass coho CU was provided by Nisga'a Fish and Wildlife. For a description of the juvenile survey's indicator, see Section 4.1.1. Overview of Biological Indicators, G: Juvenile Surveys.

H: Hatchery Releases

Hatchery releases in the Nass Region for all species were provided by DFO (Joan Bateman, Salmonid Enhancement Program). Refer to Section 4.1.1. Overview of Biological Indicators, H: Hatchery Releases for details on data and analytical methods.

I: Biological Status

The **biological status** assessments for CUs in the Nass Region currently reflect data sourced from the NCC Database that are current to 2017. As new data become available, we will update the analyses and results in this report and the Pacific Salmon Explorer. See Sections 4.1.4. Benchmarks for Assessing Biological Status and 4.1.5. Decision Rules for Assessing Biological Status for more details on biological status assessment methods.

5.2.2 Habitat Data and Analytical Methods

Nuances regarding habitat pressure indicator data and analytical methods for the Nass Region are listed below. Refer to Section 4.2 Indicators and Benchmarks for Assessing Habitat Status for information on habitat pressure indicators, benchmarks, and the analytical methods used to assess habitat status. Additional details on habitat pressure indicators, data sources, data currency, and benchmarks specific to the Nass Region are available in Appendix 6 (Description of Habitat Pressure Indicators & Relevance to Salmon), Appendix 7 (Habitat Pressure Datasets & Data Sources), Appendix 8 (Spatial Data Processing for Habitat Pressure Indicators), Appendix 9 (Spatial Data Processing for Future Pressures), and Appendix 12 (Habitat Pressure Benchmark Values by Region).

A: Transboundary Conservation Units

The pink (even-year) Nass-Skeena Estuary CU spans the boundary between the Skeena and Nass regions. For habitat indicators that used relative benchmarks, habitat status for this transboundary CU was assessed based on benchmarks derived from the Skeena region because a significant portion of this CU's spawning habitat fell inside the Skeena region.

B: Spawning Zones of Influence

Methods for delineating Chinook CU **spawning zones of influence (ZOIs)** vary by region in accordance with the CU delineation approach used by DFO. In the Skeena, Nass, and Central Coast regions, Chinook CUs are defined using a more restrictive geographic representation, which resulted in fewer (or no) spawning locations occurring within the CU boundaries. As such, spawning ZOIs for each Chinook CU were delineated using the extent of all 1:20K FWA Assessment Watersheds that directly intersected with Nass Chinook CU boundaries.

5.2.3 Results

A: Biological Status

This section provides a high-level overview of the biological status results for all 22 salmon CUs in the Nass Region. Of the 22 CUs examined in the Region, we assessed biological status for 13 CUs (59%). The remaining 9 CUs (41%) had insufficient information for evaluating their biological status (see Section 4.1.5 Decision Rules for Assessing Biological Status for the criteria used to define data deficient CUs). Of the CUs for which we assessed biological status, 10 (77%) are in the green status zone, 3 (23%) are in the amber zone, and none are in the red status zone. Biological status for all CUs is displayed by species in Figures 14-20 below. More information on biological status and benchmarks for each CU are available in Table A.7. in Appendix 4. Full results are available online through the Pacific Salmon Explorer, where individual figures, maps, data, and summary statistics are provided for each CU in the Region. The results of these assessments reflect data that are current to 2017. As new data become available, we will update the analyses and results in this report and on the Pacific Salmon Explorer.

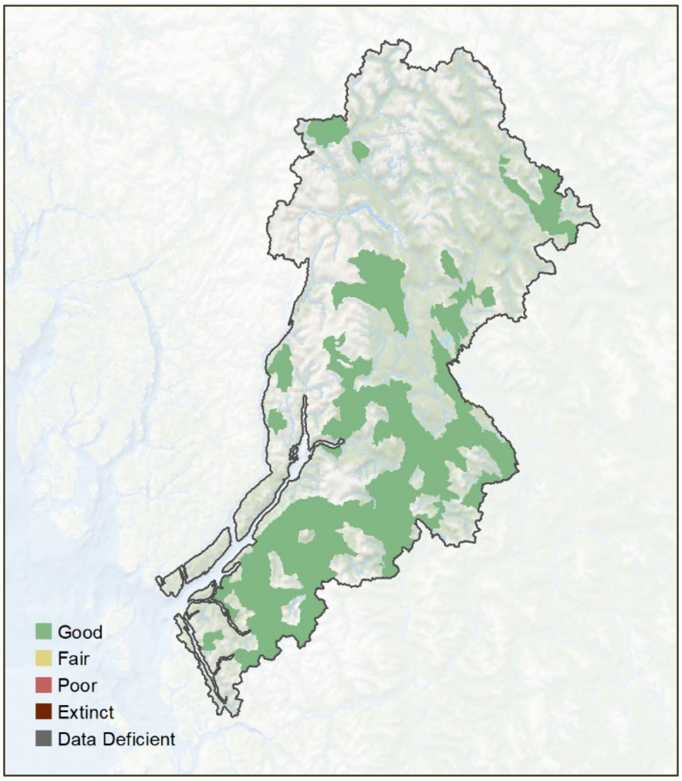

Figure 14. Pacific Salmon Foundation biological status of Nass Chinook salmon Conservation Units.

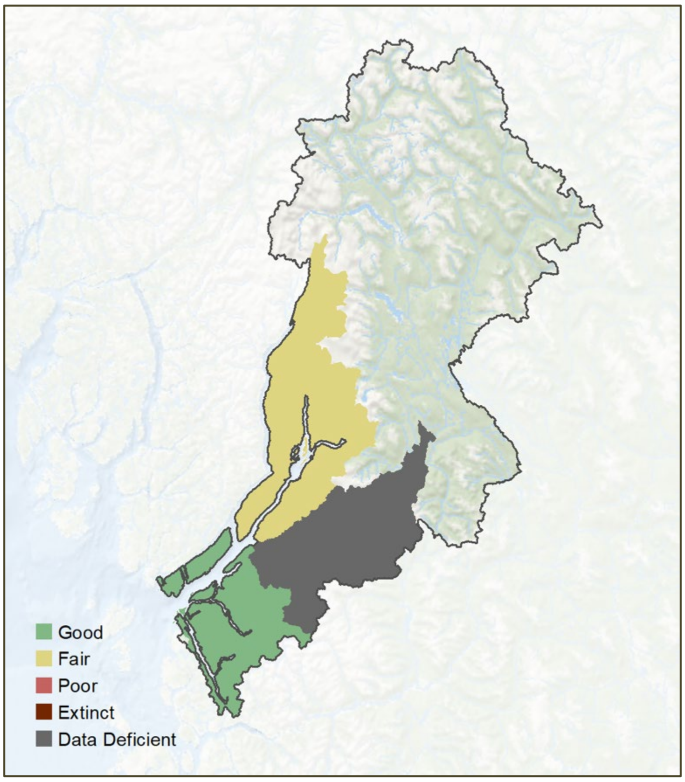

Figure 15. Pacific Salmon Foundation biological status of Nass chum salmon Conservation Units.

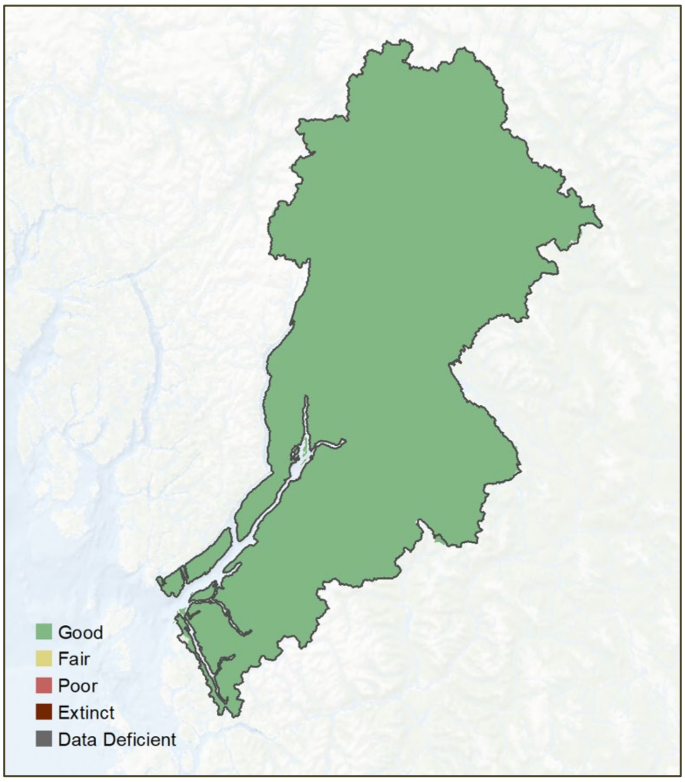

Figure 16. Pacific Salmon Foundation biological status of Nass coho salmon Conservation Units.

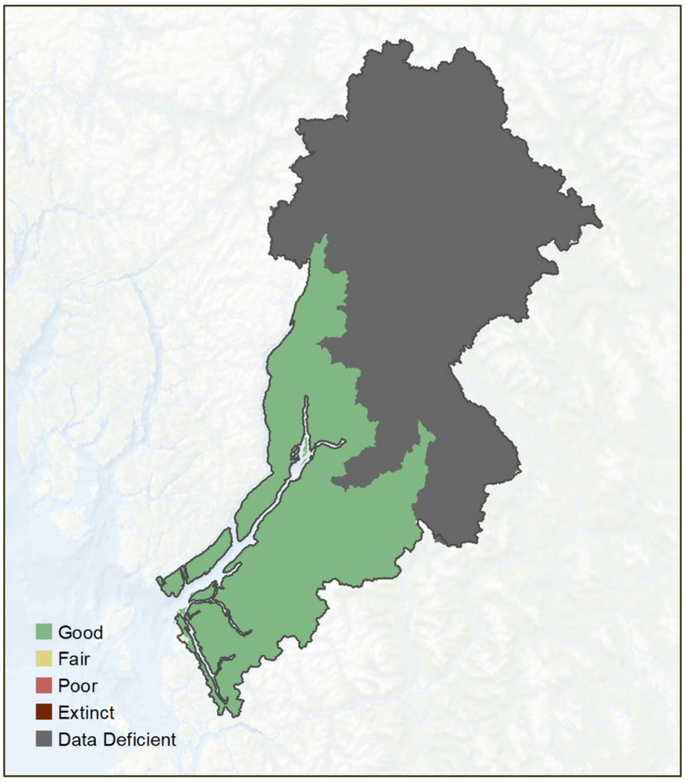

Figure 17. Pacific Salmon Foundation biological status of Nass pink (odd) salmon Conservation Units.

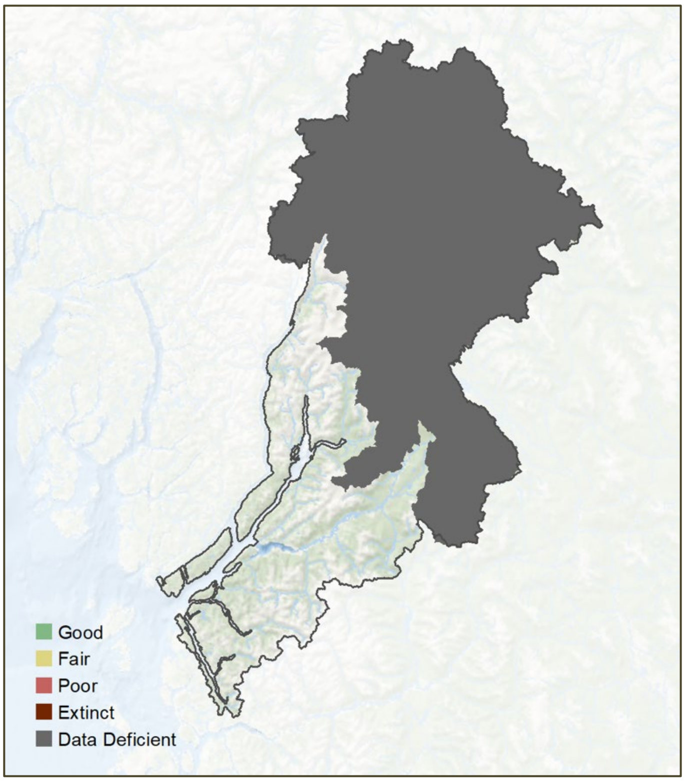

Figure 18. Pacific Salmon Foundation biological status of Nass pink (even) salmon Conservation Units.

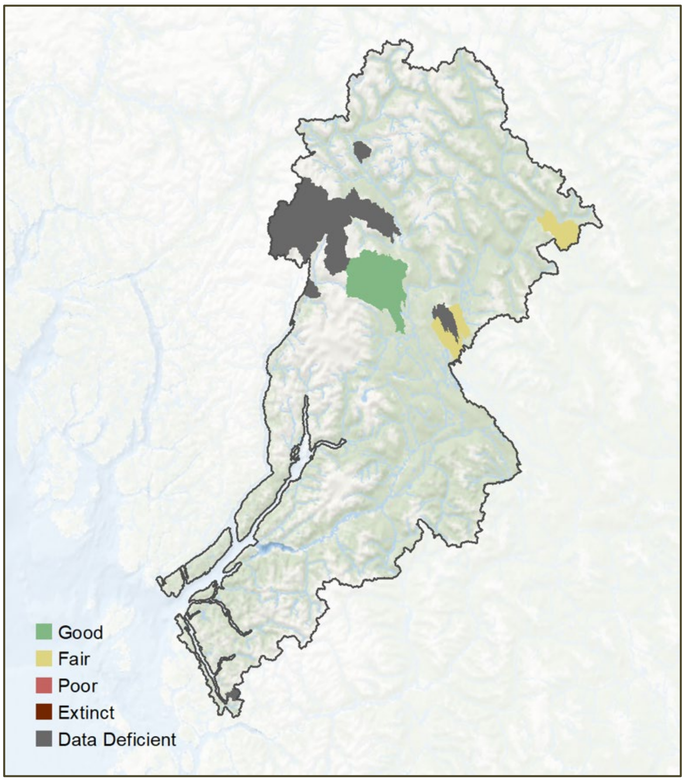

Figure 19. Pacific Salmon Foundation biological status of Nass sockeye (lake-type) salmon Conservation Units.

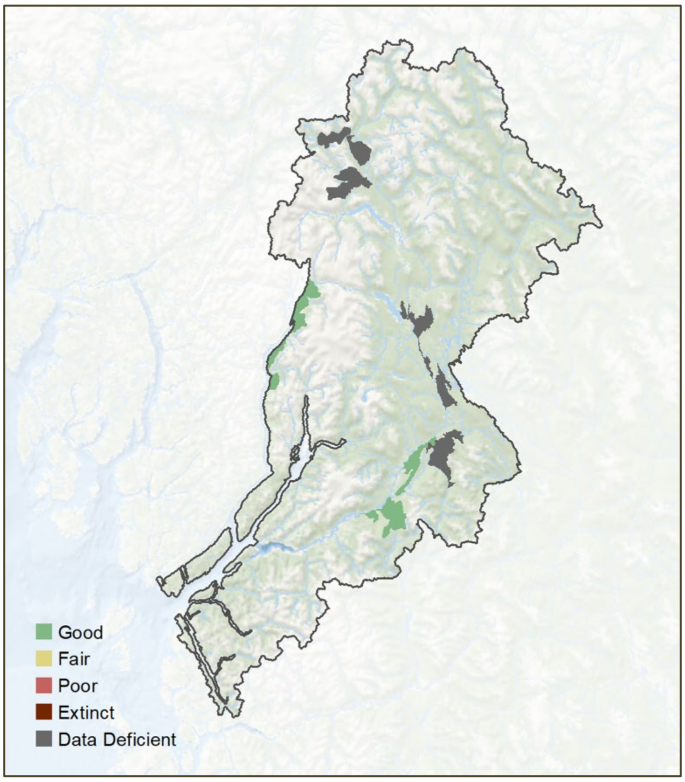

Figure 20. Pacific Salmon Foundation biological status of Nass sockeye (river-type) salmon Conservation Units.

B: Habitat Status

We completed habitat assessments for watersheds within the 22 salmon CUs in the Nass Region. The habitat assessments produce two levels of outputs for spawning ZOIs: (1) a risk rating for each FWA assessment watershed in the study area for each individual habitat pressure indicator; (2) a cumulative pressure score for each FWA assessment watershed in the study area, representing the risk to a watershed from all habitat pressures combined. Of the 550 1:20K FWA assessment watersheds assessed in the Nass Region, 42% (n= 229) were designated as spawning habitat based on compiled spawning location data. These 229 watersheds represent the combined spawning ZOI for all species. In terms of the cumulative pressure scores for the combined spawning ZOI for all species, 21% of spawning habitat in the Nass Region is high risk (red), 42% is moderate risk (amber), and 37% is low risk (green). The percentage of spawning habitat in each risk category for each indicator is summarized in Table 14 below.

Quantifying both individual and cumulative pressures at the FWA assessment watershed-scale provides a snapshot of habitat pressures across the Nass Region and highlights which CUs face the greatest risk. Specifically, an overview of habitat pressures emerges from identifying:

the percentage area of the combined spawning ZOI for all species that is rated high, moderate, or low risk (i.e. red, amber, green) for each of the evaluated individual habitat pressure indicators; and the percentage area of the combined spawning ZOI for all species that is rated high, moderate, or low risk (i.e. red, amber, green) for cumulative habitat pressures.

More information on habitat pressure benchmark values for each indicator is available in Appendix 12. More information on cumulative spawning Pressure Results by Region and Conservation Unit is available in Appendix 13. Full results are available online through the Pacific Salmon Explorer. The results can be downloaded directly from the Pacific Salmon Explorer for each CU. The datasets compiled for the analysis are also available for download via the Salmon Data Library.

Table 14. The percentage of area within the Nass Region's combined spawning ZOI for all species rated high, moderate, or low risk (i.e. red, amber, green) for cumulative pressures and for each evaluated individual habitat pressure indicator.

Indicator	% Area of Spawning Habitat		
	High Risk	Moderate Risk	Low Risk
Total Landcover Alteration	21%	53%	27%
Forest Disturbance	23%	32%	45%
Impervious Surfaces	0%	2%	98%
Mines	10%	0%	90%
Linear Development	23%	43%	33%
Road Development	6%	20%	73%
Stream Crossing Density	22%	31%	47%
Riparian Disturbance	11%	22%	67%
Water Licenses	6%	0%	94%
Waste Water Discharges	0%	0%	100%
Equivalent Clearcut Area	0%	0%	100%
Insect and Disease Defoliation	72%	0%	28%
Cumulative Pressures	21%	42%	37%

5.3 Central Coast Region

The Central Coast Region supports more than 114 CUs of all five Pacific salmon species (Figure 21). While this area is less easily defined than an extensive river system such as the Skeena or Fraser Regions, we could determine the Central Coast study area using three criteria. First, the intent was to include the full geographic extent of most CUs on the Central Coast (Appendix 1). Second, we considered the adjacency of other Regions within the Pacific Salmon Explorer to minimize overlap between study areas. Third, we considered major drainage patterns as represented in BC's Freshwater Atlas (FWA) 1:20K Watershed Groups (MOE, 2017a). According to these criteria, the resulting Central Coast Region on the Pacific Salmon Explorer encompasses 54,813 km^2 from Smith and Rivers Inlets in the south, and Douglas Channel and Banks, McCauley, and Pitt Islands in the north (Figure 21). The process of data gathering, synthesis, outreach, and engagement to complete the initial assessments within the Central Coast Region was conducted over two years, from 2016 to 2018.

For the Central Coast Region, we worked with two technical committees (one for the north portion and one for the south portion of the region) to garner feedback on the Pacific Salmon Explorer approach and analyses. These Technical committees were comprised of First Nations, DFO regional biologists, managers, and other salmon experts to garner feedback on the Pacific Salmon Explorer approach and analyses. We received feedback from the Central Coast Indigenous Resource Alliance through a series of North and South Technical Committee Meetings and the Nuxalk, Kitasoo/Xai'Xais, Heiltsuk, Wuikinuxv Gitxaala, and Haisla First Nations.

As part of the Technical Committee review process, we removed two CUs from the project (Whalen Lake and Owikeno-Late sockeye (lake-type) CUs). The Whalen Lake sockeye CU is included in Holtby and Ciruna (2007), but long-time Charter Patrolman and Technical Committee member, Stan Hutchings, recommended removing it from the list of CUs. An impassable waterfall prevents sockeye from accessing Whalen Lake, which is the spawning and rearing lake for this CU. As such, we removed this CU from the project. The Owikeno-Late sockeye CU is not listed in Holtby and Ciruna (2007) but was provisionally designated as a CU by Blair Holtby in 2008. However, a Technical Committee member from Wuikinuxv advised us that this CU is not distinguishable from other sockeye CUs in the lake. Furthermore, this CU was not included on the most recent list of CUs published on the Government of Canada's OpenData portal. Given that it was not in the most current list of CUs, it lacks baseline data, and we could not find any documentation about its creation. Therefore, we removed this CU from the project.

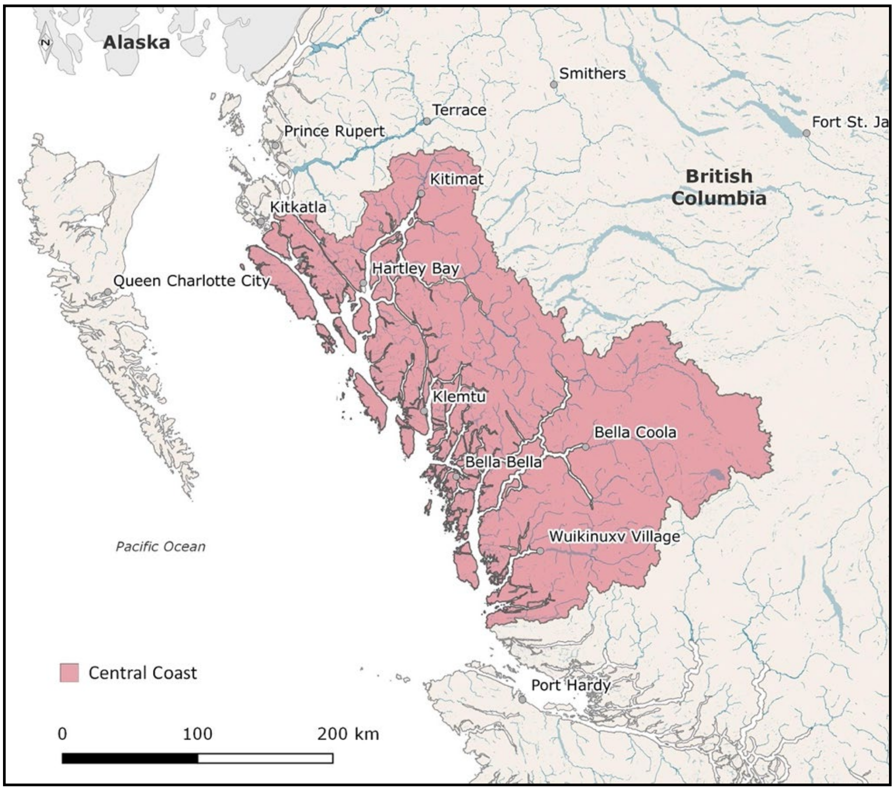

Figure 21. Map of the Central Coast Region.

5.3.1 Biological Data and Analytical Methods

There are several nuances to the data sources and analytical methods specific to the Central Coast Region. These nuances are listed below.

A: Spawner Surveys

Spawner survey data for streams on the Central Coast were sourced from DFO's New Salmon Escapement Database (NuSEDS). For a description of the spawner survey indicator, see Section 4.1.1. Overview of Biological Indicators, A: Spawner Surveys.

B: Spawner Abundance

Observed spawner abundance for CUs on the Central Coast is the sum of all spawner survey data as documented in NuSEDS, as described in Section 4.1.1. Overview of Biological Indicators, B: Spawner Abundance. Similar to our work in the Skeena and Nass, we accessed most of these datasets via the North and Central Coast (NCC) database, maintained by LGL Ltd. (English et al., 2018).

Central Coast CU-level **estimates of spawner abundance** (run reconstructions) were sourced from the North and Central Coast (NCC) database. In addition, updated estimated spawner abundance data for the South

Atnarko Lakes CU was accessed from DFO (Connors et al., 2016). Central Coast CU-level estimated spawner abundance time series were developed for the NCC database according to the expansion factors described in the Skeena Region section above.

C: Run Timing

We currently do not have CU-level **run timing** data for any CUs in the Central Coast Region. We will update this information as CU-level run timing data become publicly available. See Section 4.1: Overview of Biological Indicators, C: Run Timing for a description of the run timing indicator and methods.

D: Catch & Run Size

Catch and run size and subsequent exploitation rates for CUs on the Central Coast were calculated by DFO and LGL from data in the Fisheries Operating System (FOS) and other DFO databases. Similar to our work in the Skeena and Nass, we accessed most of these datasets via the North and Central Coast (NCC) Database, maintained by LGL Ltd. (English et al., 2018). In addition, we sourced updated catch data from DFO for the South Atnarko Lakes CU (Connors et al., 2016). For a description of catch and run size methods, see Section 4.1.1. Overview of Biological Indicators, D: Catch & Run Size.

E: Recruits-per-Spawner

Recruits-per-spawner data for CUs on the Central Coast were derived from the DFO age database and CU-level estimates of spawner abundance and catch and run size accessed from the NCC Database (English et al., 2018). For a description of recruits-per-spawner methods, see Section 4.1.1. Overview of Biological Indicators, E: Recruits-per-Spawner.

F: Trends in Spawner Abundance

Trends in spawner abundance for CUs on the Central Coast were derived from the CU-level estimates of spawner abundance accessed from the NCC database (English et al., 2018). For a description of trends in spawner abundance methods, see Section 4.1.1. Overview of Biological Indicators, F: Trends in Spawner Abundance.

G: Juvenile Surveys

Smolt abundance data for the Hecate Lowlands (even) pink, Hecate Strait-Lowlands (odd) pink, Hecate Strait Mainland coho, Hecate Lowlands chum, Roderick sockeye, and Mary Cove Creek sockeye CUs within Kitasoo/Xai'xais territory were provided by Larry Greba (Kitasoo/Xai'xais Development Corporation). For a description of the juvenile survey's indicator, see Section 4.1.1. Overview of Biological Indicators, G: Juvenile Surveys.

H: Hatchery Releases

Hatchery releases in the Central Coast Region for all species were provided by DFO (Joan Bateman, Salmonid Enhancement Program). Refer to Section 4.1.1. Overview of Biological Indicators, H: Hatchery Releases for details on data and analytical methods.

I: Biological Status

The **biological status** assessments for CUs in the Central Coast Region currently reflect data sourced from the NCC Database current to 2017. As new data become available, we will update the analyses and results in this report and the Pacific Salmon Explorer. See Sections 4.1.4. Benchmarks for Assessing Biological Status and 4.1.5. Decision Rules for Assessing Biological Status for more details on biological status assessment methods.

5.3.2 Habitat Data and Analytical Methods

Nuances regarding habitat pressure indicator data and analytical methods for the Central Coast Region are listed below. Refer to Section 4.2 Indicators and Benchmarks for Assessing Habitat Status for information on habitat pressure indicators, benchmarks, and the analytical methods used to assess habitat status. Additional details on habitat pressure indicators, data sources, data currency, and benchmarks specific to the Central Coast Region are available in Appendix 6 (Description of Habitat Pressure Indicators & Relevance to Salmon), Appendix 7 (Habitat Pressure Datasets & Data Sources), Appendix 8 (Spatial Data Processing for Habitat Pressure Indicators), Appendix 9 (Spatial Data Processing for Future Pressures), and Appendix 12 (Habitat Pressure Benchmark Values by Region).

A: Transboundary Conservation Units

The pink (odd-year) Homathko-Klinaklini-Smith-Rivers-Bella Coola-Dean Conservation Unit spans the boundary between the Central Coast and Vancouver Island & Mainland Inlets regions. For habitat indicators that used relative benchmarks, habitat status for this transboundary conservation unit was assessed based on benchmarks derived from the Central Coast region because a significant portion of spawning habitat for this conservation unit fell inside the Central Coast region.

B: Spawning Zones of Influence

Methods for delineating Chinook CU **spawning zones of influence (ZOIs)** vary by region in accordance with the CU delineation approach used by DFO. In the Skeena, Nass, and Central Coast regions, Chinook CUs are defined using a more restrictive geographic representation, which resulted in fewer (or no) spawning locations occurring within the CU boundaries. As such, spawning ZOIs for each

Chinook CU were delineated using the extent of all 1:20K FWA Assessment Watersheds that directly intersected with Central Chinook CU boundaries.

C: Additional Spawning Habitat Information Sources

In addition to the spawning habitat information we acquired from the Fisheries Information Summary System (FISS) database and local knowledge derived through expert elicitation, we received additional spawning habitat information from a technical report provided by Diana Chan and Mike Reid (Fisheries, Heiltsuk First Nation; Temple, 2007).

5.3.3 Results

A: Biological Status

This section provides a high-level overview of the biological status results for all 114 salmon CUs in the Central Coast Region. Of the 114 CUs we examined in the Region, we assessed biological status for 49 CUs (43%). The remaining 65 salmon CUs (57%) had insufficient information for evaluating their biological status (see Section 4.1.5 Decision Rules for Assessing Biological Status for the criteria used to define data deficient CUs). Of the CUs for which we were able to assess biological status, 34 (69%) are in the green status zone, 2 (4%) are in the amber zone, and 13 (27%) are in the red status zone. Biological status for all CUs is displayed by species in Figures 22-28 below. More information on biological status and benchmarks for each CU is available in Table A.8; Appendix 4. Full results are available online through the Pacific Salmon Explorer, where individual figures, maps, data, and summary statistics are provided for each CU in the Region. The results of these assessments reflect data that are current to 2017. As new data becomes available, we will update the analyses and results in this report and on the Pacific Salmon Explorer.

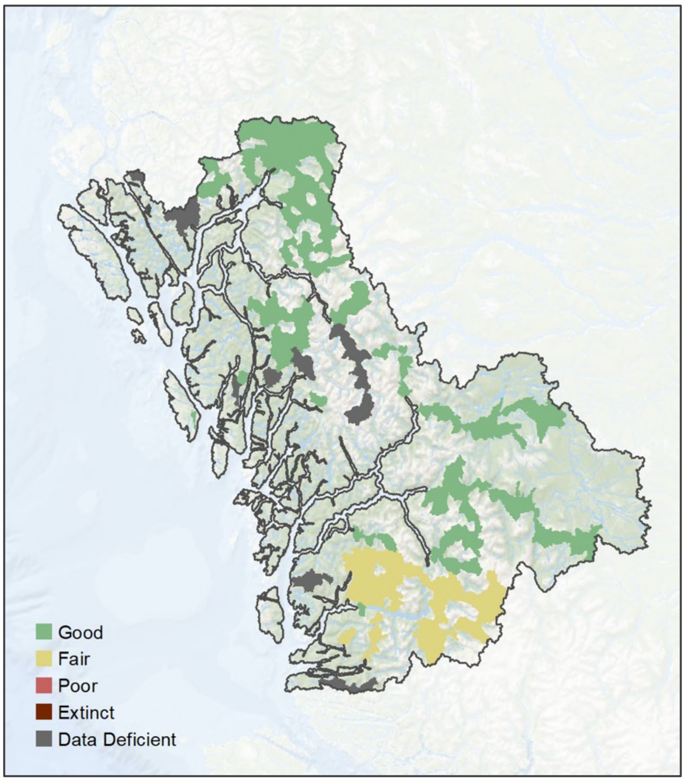

Figure 22. Pacific Salmon Foundation biological status of Central Coast Chinook salmon Conservation Units.

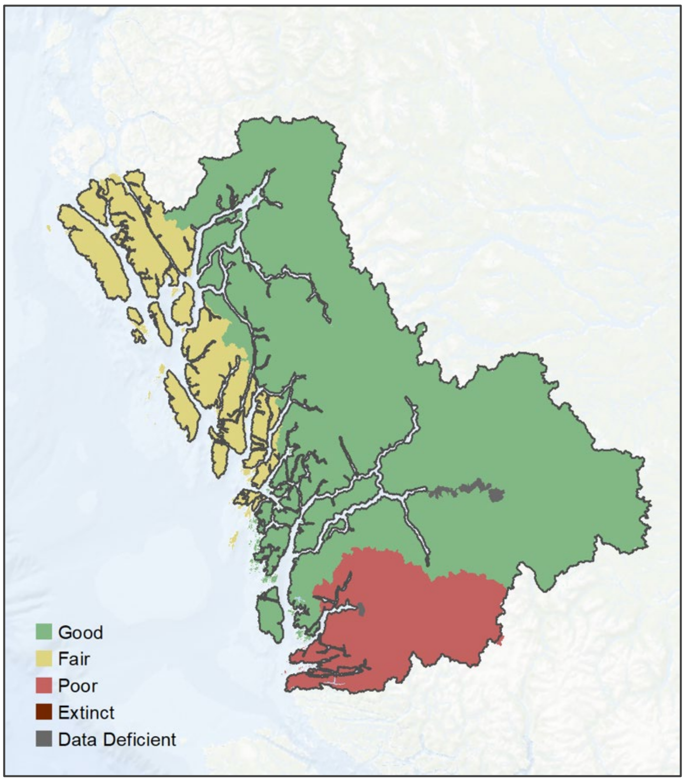

Figure 23. Pacific Salmon Foundation biological status of Central Coast chum salmon Conservation Units.

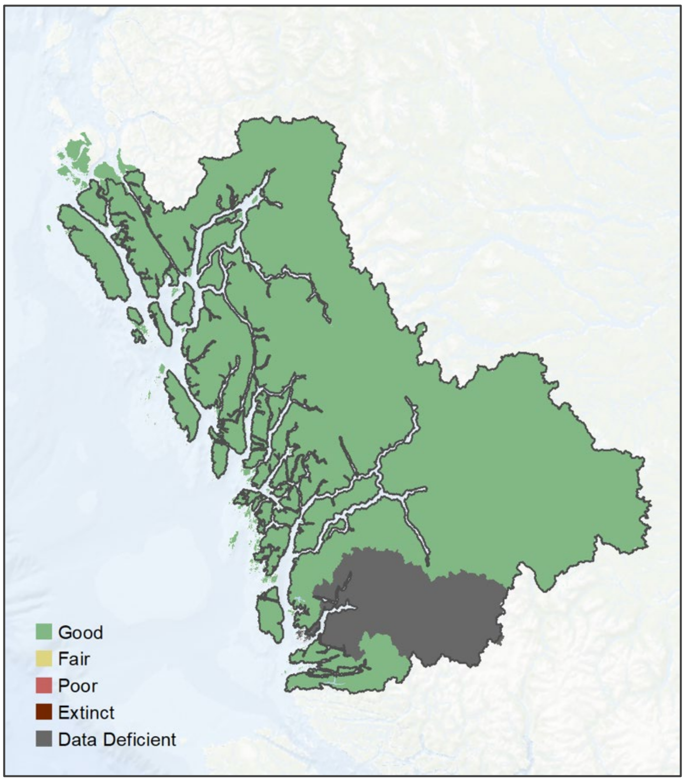

Figure 24. Salmon Foundation biological status of Central Coast coho salmon Conservation Units.

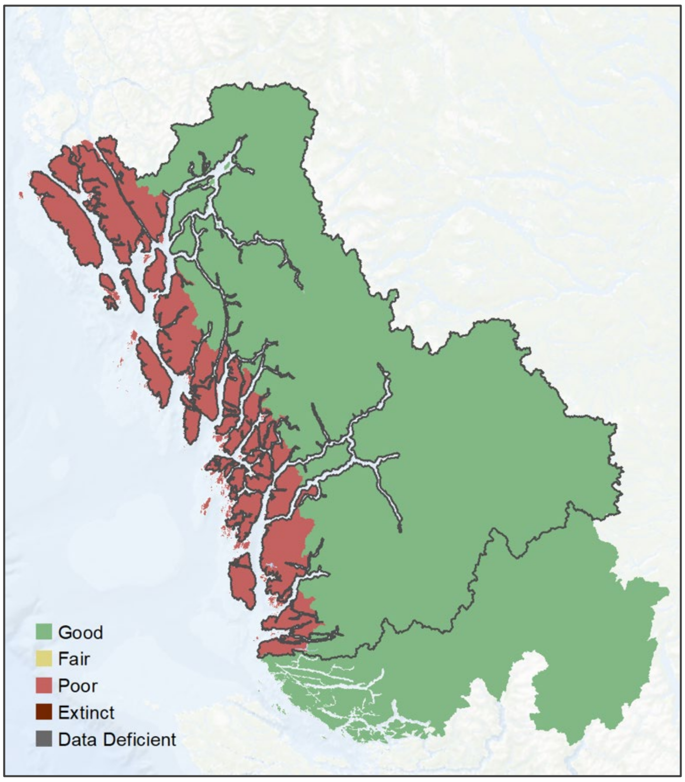

Figure 25. Pacific Salmon Foundation biological status of Central Coast pink (odd) salmon Conservation Units.

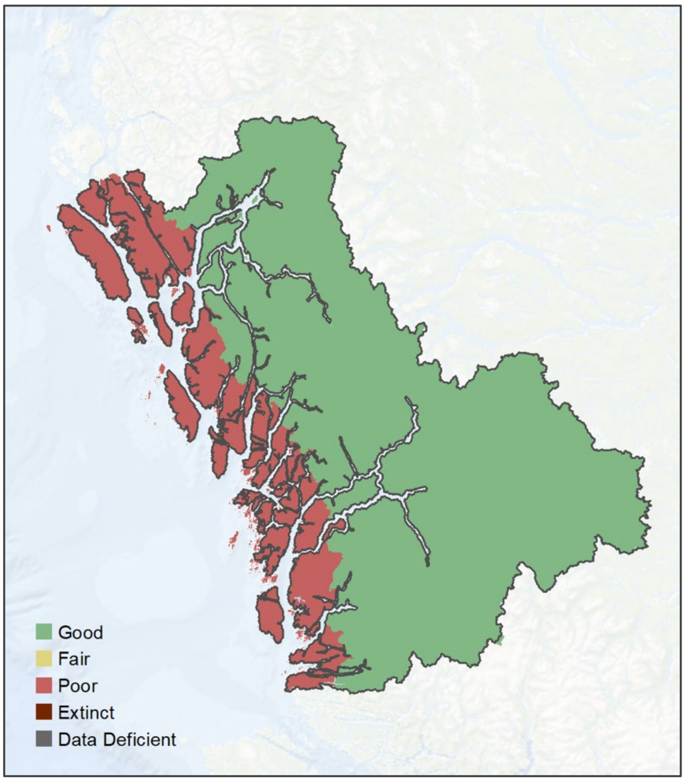

Figure 26. Pacific Salmon Foundation biological status of Central Coast pink (even) salmon Conservation Units.

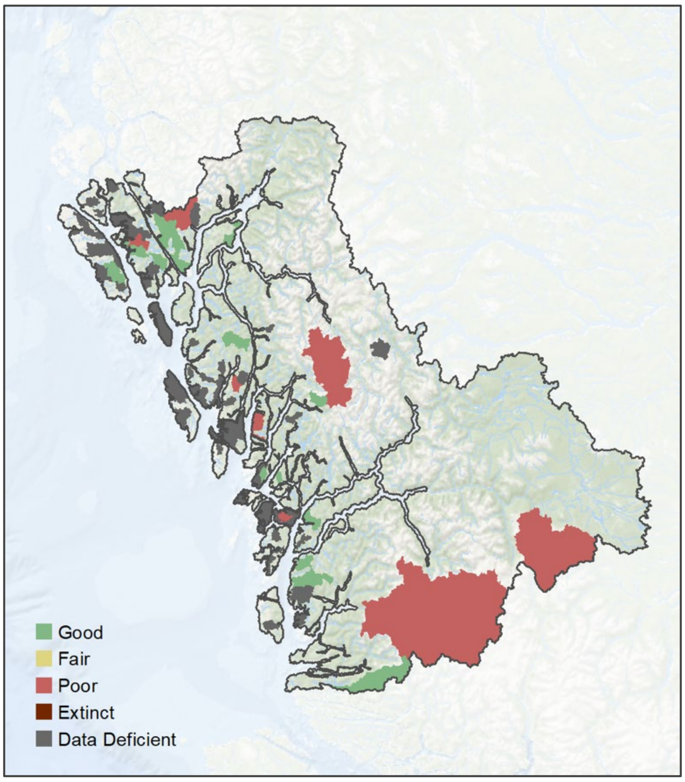

Figure 27. Pacific Salmon Foundation biological status of Central Coast sockeye (lake-type) salmon Conservation Units.

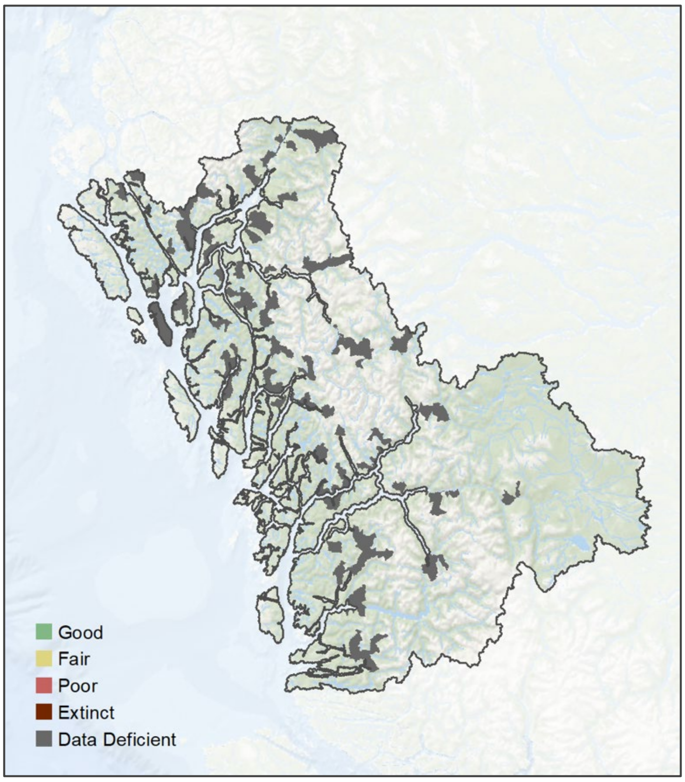

Figure 28. Pacific Salmon Foundation biological status of Central Coast sockeye (river-type) salmon Conservation Units.

B: Habitat Status

We completed habitat assessments for watersheds within the 114 salmon CUs in the Central Coast Region. The habitat assessments produce two levels of outputs for spawning ZOIs: (1) a risk rating for each FWA assessment watershed in the study area for each individual habitat pressure indicator; (2) a cumulative pressure score for each FWA assessment watershed in the study area, representing the risk to a watershed from all habitat pressures combined. Of the 1,132 1:20K, FWA assessment watersheds assessed in the Central Coast Region, 63% (n=709) were designated as spawning habitat based on compiled spawning location data. These 709 watersheds represent the combined spawning ZOI for all species. In terms of the cumulative pressure scores for the combined spawning ZOI for all species, 9% of spawning habitat in the Central Coast Region is high risk (red), 28% is moderate risk (amber), and 62% is low risk (green). The percentage of spawning habitat in each risk category for each indicator is summarized in Table 15 below.

Quantifying both individual and cumulative pressures at the FWA assessment watershed-scale provides a snapshot of habitat pressures across the entire Central Coast and highlights which CUs face the greatest risk. Specifically, an overview of habitat pressures emerges from identifying:

the percentage area of the combined spawning ZOI for all species that is rated high, moderate, or low risk (i.e. red, amber, green) for each of the evaluated individual habitat pressure indicators; and the percentage area of the combined spawning ZOI for all species that is rated high, moderate, or low risk (i.e. red, amber, green) for cumulative habitat pressures;

More information on habitat pressure benchmark values for each indicator is available in Appendix 12. More information on cumulative spawning Pressure Results by Region and Conservation Unit is available in Appendix 13. Full results are available online through the Pacific Salmon Explorer. The results can be downloaded directly from the Pacific Salmon Explorer for each CU. The datasets compiled for the analysis are also available for download via the Salmon Data Library.

Table 15. The percentage of area within the Central Coast Region's combined spawning ZOI for all species rated high, moderate, or low risk (i.e. red, amber, green) for cumulative pressures and each of the evaluated individual habitat pressure indicators.

Indicator	% Area of Spawning Habitat		
	High Risk	Moderate Risk	Low Risk
Total Landcover Alteration	10%	53%	37%
Forest Disturbance	15%	38%	47%
Impervious Surfaces	0%	2%	98%
Mines	4%	0%	96%
Linear Development	9%	44%	48%
Road Development	4%	18%	79%
Stream Crossing Density	28%	5%	68%
Riparian Disturbance	9%	18%	73%
Water Licenses	7%	0%	93%
Waste Water Discharges	2%	0%	98%
Equivalent Clearcut Area	0%	0%	100%
Insect and Disease Defoliation	11%	0%	89%
Cumulative Pressures	9%	28%	62%

5.4 Fraser Region

The Fraser River watershed and adjacent coastal watersheds (collectively, the "Fraser Region"; Figure 29) support an incredible diversity of Pacific salmon with 62 Conservation Units. There are 8 CUs in the Fraser Region designated as extinct by DFO, two of which have been reintroduced and are new de novo CUs (Appendix 1). DFO officially uses the European designation to indicate age class for CUs within the Fraser Region. However, in the Pacific Salmon Explorer and this report, we use the Gilbert-Rich designation, which is more familiar to most users. We made this decision based on feedback from the Population Science Advisory Committee and other local users in the Region. The process of data gathering, synthesis, outreach, and engagement to complete the initial assessments within the Fraser Region was conducted over two years, from the spring of 2018 to 2020.

Within the Fraser Region, we worked with First Nations, DFO regional biologists and managers, and other salmon experts to garner feedback on the Pacific Salmon Explorer approach and analyses through four sub-regions according to geographic and social groupings: Lower Fraser, Middle Fraser - Mainstem, Middle Fraser - Thompson, and Upper Fraser. Through a series of introductory and Technical Meetings, we received feedback from First Nation aggregate organizations and individual First Nations across those areas, including the Lower Fraser Fisheries Alliance (LFFA) and Lower Fraser First Nations, Secwepemc Fisheries Commission (SFC), and SFC First Nations, Scw'exmx Tribal Council (STC), St'at'imc Chiefs Council (SCC) and member Nations, Nlaka'pamux Nation Tribal Council (NNTC) and NNTC First Nations, Okanagan Nation Alliance (ONA), and the Upper Fraser Fisheries Conservation Alliance including members of the Tsilhqot'in National Government, Carrier-Sekani Tribal Council (CSTC), North Shuswap Tribal Council (NSTC), and Carrier-Chilcotin Tribal Council (CCTC).

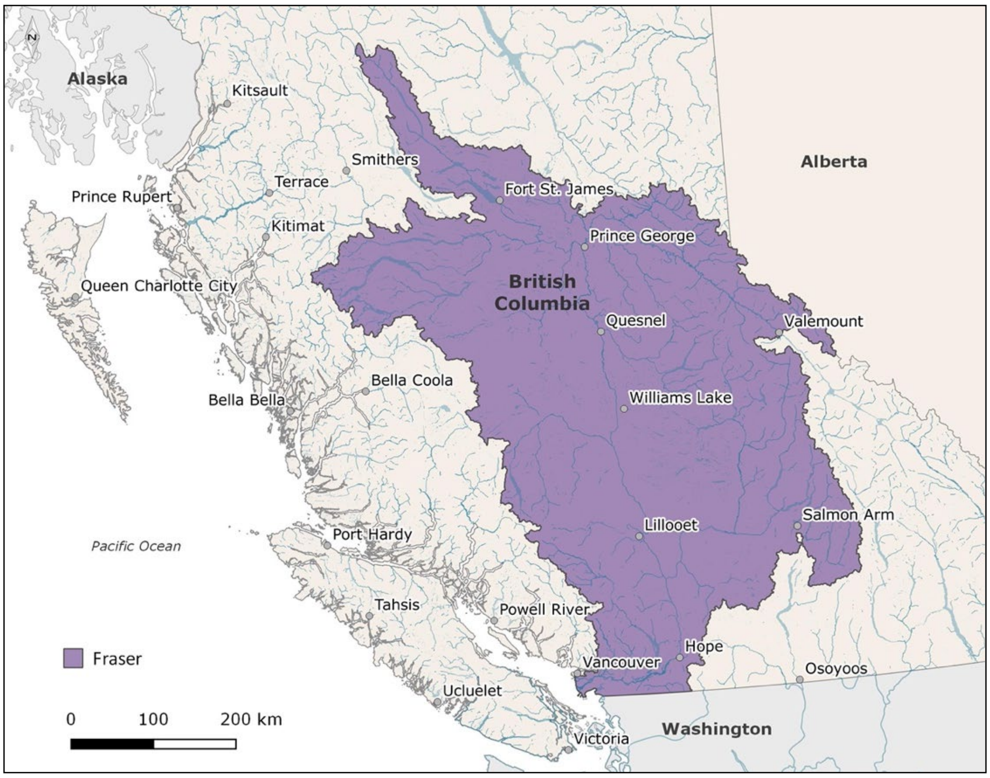

Figure 29. Map of Fraser Region.

5.4.1 Biological Data and Analytical Methods

In the Fraser Region, we accessed datasets for biological status and indicators directly from DFO staff. Additional data was sourced from NuSEDS, FOS, and the Pacific Salmon Commission. Details on specific data sources and analytical methods for the Fraser Region are described below.

A: Spawner Surveys

Spawner survey data for streams in the Fraser Region were sourced from DFO's New Salmon Escapement Database (NuSEDS). For a description of the spawner survey indicator, see Section 4.1.1. Overview of Biological Indicators, A: Spawner Surveys.

B: Spawner Abundance

In the Fraser Region, observed spawner abundance is the sum of all spawner survey data documented in NuSEDS, as described in Section 4.1.1. Overview of Biological Indicators, B: Spawner Abundance.

Estimated spawner abundance in Fraser Region is not available from a centralized database as it is in the North and Central Coast through the NCC Database (English et al., 2018). Estimates of spawner abundance were acquired from specific DFO biologists with the following species-specific nuances. For sockeye, we visualize Effective Total Spawners, which reflects an estimate provided by DFO of successfully spawned female and male sockeye, accounting for pre-spawn mortality (during migration; provided by Tracy Cone, DFO Stock Assessment, Sockeye & Pink Analytical Program). For pink salmon, we visualize a dataset acquired from the Pacific Salmon Commission (Fiona Martens, Pacific Salmon Commission). This dataset has some uncertainty as the enumeration program for pink salmon escapement in the Fraser River has varied over time. Specifically, DFO stopped conducting spawner survey programs for pink salmon in 2001; therefore, estimates from 2003-2007 are based on test fishing programs in the marine approach area before river entry and within the lower Fraser River. Estimates from 2009 onwards are based on the hydroacoustics program run by the Pacific Salmon Commission at Mission. For Chinook, estimated spawner abundance was generated through the Southern BC Chinook Technical Working Group (Brown et al., 2020).

In contrast to estimated spawner abundance values for other species and areas, values for Fraser Chinook are only a subset of those available for the entire CU. These values are based on the most intensively monitored streams (i.e. there is no expansion made so that the estimated value represents CU as the whole). The year at which each estimate spawner abundance time series for Chinook also varies based on the availability and quality of data, with the start year of the time series determined by expert opinion (Brown et al., 2020). For coho, estimated spawner abundance was sourced from Korman et al. (2019). There are no CU-level estimates of spawner abundance for chum salmon in the Fraser River. Thus, biological status of chum are data deficient for this Region.

C: Run Timing

Run timing estimates were provided for all 25 Fraser sockeye CUs (Fiona Martens, Pacific Salmon Commission). The median estimate date and spread represent the run timing date through DFO Area 20 for each management unit from 1980 to 2017. Each CU within a management unit was assumed to have the same run timing. See Section 4.1.1. Overview of Biological Indicators, C: Run Timing for a description of the run timing indicator and methods.

D: Catch & Run Size

Catch and run size data were provided for pink (Fiona Martens, Pacific Salmon Commission) and Sockeye (Mike Lapointe, Pacific Salmon Commission) in the Fraser Region. For a description of catch and run size methods, see Section 4.1.1. Overview of Biological Indicators, D: Catch & Run Size*.*

E: Recruits-per-Spawner

Recruits-per-spawner data were derived by DFO and provided for pink (Fiona Martens, Pacific Salmon Commission) and sockeye (Tracy Cone, DFO Stock

Assessment, Sockeye & Pink Analytical Program) in the Fraser Region. For a description of recruits-per-spawner methods, see Section 4.1.1. Overview of Biological Indicators, E: Recruits-per-Spawner.

F: Trends in Spawner Abundance

Trends in spawner abundance were derived for pink, Chinook, and sockeye from the estimated spawner abundance data provided by the Pacific Salmon Commission (Fiona Martens), Brown et al. (2020), and DFO (Tracy Cone, DFO Stock Assessment, Sockeye & Pink Analytical Program) respectively. For a description of trends in spawner abundance methods, see Section 4.1.1. Overview of Biological Indicators, F: Trends in Spawner Abundance.

G: Juvenile Surveys

In the Fraser Region, we accessed **smolt survey** data for two sockeye CUs: Cultus Lake (provided by Mike Bradford, DFO Ecosystem Sciences Division, Freshwater Ecosystems) and Chilko-Summer (provided by Mike Hawkshaw, DFO Stock Assessment, Sockeye & Pink Analytical Program). Smolt abundance data are collected at Cultus Lake, within the Lower Fraser River, at a counting fence on Sweltzer Creek, the downstream outlet of the lake. DFO has been monitoring smolt outmigration at Sweltzer Creek since 1926. Similarly, smolt abundance at Chilko Lake has also been monitored by DFO in collaboration with local First Nations fisheries technicians at a smolt counting fence each spring since 1949. For a description of the juvenile survey indicator, see Section 4.1.1. Overview of Biological Indicators, G: Juvenile Surveys.

H: Hatchery Releases

Hatchery releases in the Fraser Region for all species were provided by DFO (Joan Bateman, Salmonid Enhancement Program). Refer to Section 4.1.1. Overview of Biological Indicators, H: Hatchery Releases for details on data and analytical methods.

I: *Biological Status*

Nuances regarding biological status assessments for Fraser CUs are listed below. See Sections 4.1.4. Benchmarks for Assessing Biological Status and 4.1.5. Decision Rules for Assessing Biological Status for more details on biological status assessment methods.

i. Southern BC Chinook CUs

For 19 Southern BC Chinook CUs in the Fraser Region, we only visualize biological status assessed in the most recent Wild Salmon Policy report (DFO, 2018) and status assessments completed by COSEWIC (COSEWIC, 2018) for several reasons. First, there are no CU-level spawner-recruitment data available for these CUs. Thus, we cannot apply our spawner-recruitment benchmarks to assess status (see Section 4.1.5. Decision Rules for Assessing Biological Status). In addition, these CUs likely exhibit low productivity (<1.5%) and a relatively high exploitation rate (>40%). As a result, it is inappropriate to use our percentile benchmarks because it has been shown to result in status assessments that are not precautionary (Holt et al., 2018). The WSP and COSEWIC approaches apply these CUs because they apply multiple metrics and expert judgment to assess status.

ii. Fraser sockeye with cyclic dominance

For some sockeye CUs, annual cycle lines over time fluctuate in abundance by many orders of magnitude in relatively predictable patterns over a 4-year cycle. These patterns termed "cyclic dominance," are characterized by one dominant cycle line that is very abundant, one that is sub-dominant and of moderate abundance, and two that have very low abundance. Delayed density-dependent mortality (i.e. interactions between cycle lines, which cause the survival of year-classes that follow the most abundant year to be reduced) is believed to be an important contributing factor to these large variations in abundance among brood lines. However, the exact operating mechanism remains unclear. For some CUs, brood line dominance has shifted over time, i.e. the same brood year is not consistently the dominant brood line over the entire modern time series.
While cyclic dominance may be a factor in many sockeye CUs, it has only been explicitly documented for six sockeye CUs within the Fraser Region. Consequently, this phenomenon is only a consideration for our work on the Pacific Salmon Explorer for the Fraser Region. For these six cyclic CUs, we only visualize biological status as assessed by DFO and reported in the most recent Wild Salmon Policy report (DFO, 2018; see Section 4.1.5. Decision Rules for Assessing Biological Status). The reason for this is due to the complexity of their life history and the resulting challenges with applying our standardized approach to assessing biological status using either spawner-recruitment or percentile benchmarks. The WSP and COSEWIC approaches apply these CUs because they apply multiple metrics and expert judgment to assess status.

5.4.2 Habitat Data and Analytical Methods

Nuances regarding habitat pressure indicator data and analytical methods for the Fraser Region are listed below. Refer to Section 4.2 Indicators and Benchmarks for Assessing Habitat Status for information on habitat pressure indicators, benchmarks, and the analytical methods used to assess habitat status. Additional details on habitat pressure indicators, data sources, data currency, and benchmarks specific to the Fraser Region are available in Appendix 6 (Description of Habitat Pressure Indicators & Relevance to Salmon), Appendix 7 (Habitat Pressure Datasets & Data Sources), Appendix 8 (Spatial Data Processing for Habitat Pressure Indicators), Appendix 9 (Spatial Data Processing for Future Pressures), and Appendix 12 (Habitat Pressure Benchmark Values by Region).

A: Spawning Zones of Influence

Methods for delineating Chinook CU **spawning zones of influence (ZOIs)** vary by region in accordance with the CU delineation approach used by DFO. In the Fraser and Vancouver Island and Mainland Inlet regions, Chinook CUs are geographically more broadly defined, which means that the methods employed for determining pink, chum, and coho spawning ZOIs were also applicable to Chinook CUs. The localized spawning ZOI for each Fraser Chinook CU was delineated by capturing the extent of all 1:20K FWA assessment watersheds that directly intersect with known spawning locations for Chinook.

5.4.3 Results

A: Biological Status

This section provides a high-level overview of the biological status results for all 62 salmon CUs in the Fraser Region. Of the 62 CUs we examined in the Region, we assessed biological status for 17 CUs (33%). Of the remaining 45 salmon CUs, eight were extinct (16%), and 37 (51%) had insufficient information for evaluating their biological status (see Section 4.1.5 Decision Rules for Assessing Biological Status for the criteria used to define data deficient CUs). Of the CUs for which we were able to assess biological status, 4 (24%) are in the green status zone, 5 (29%) are in the amber zone, and 8 (47%) are in the red status zone. Biological status for all CUs is displayed by species in Figures 30-35 below. More information on biological status and benchmarks for each CU is available in Table A.10 in Appendix 4. Full results are available online through the Pacific Salmon Explorer, where individual figures, maps, data, and summary statistics are provided for each CU in the Region. The results of these assessments reflect data that are current to 2018. As new data becomes available, we will update the analyses and results in this report and on the Pacific Salmon Explorer.

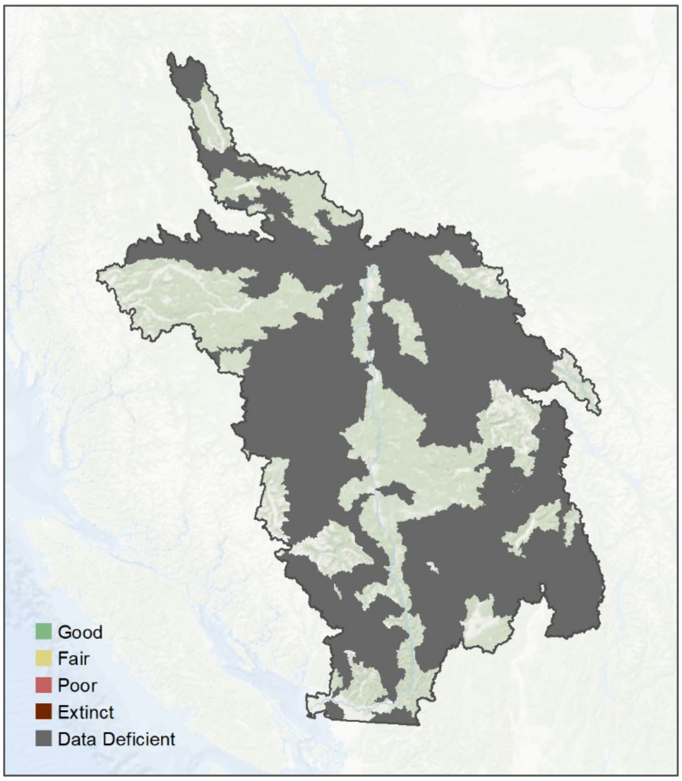

Figure 30. Pacific Salmon Foundation biological status of Fraser Chinook salmon Conservation Units.

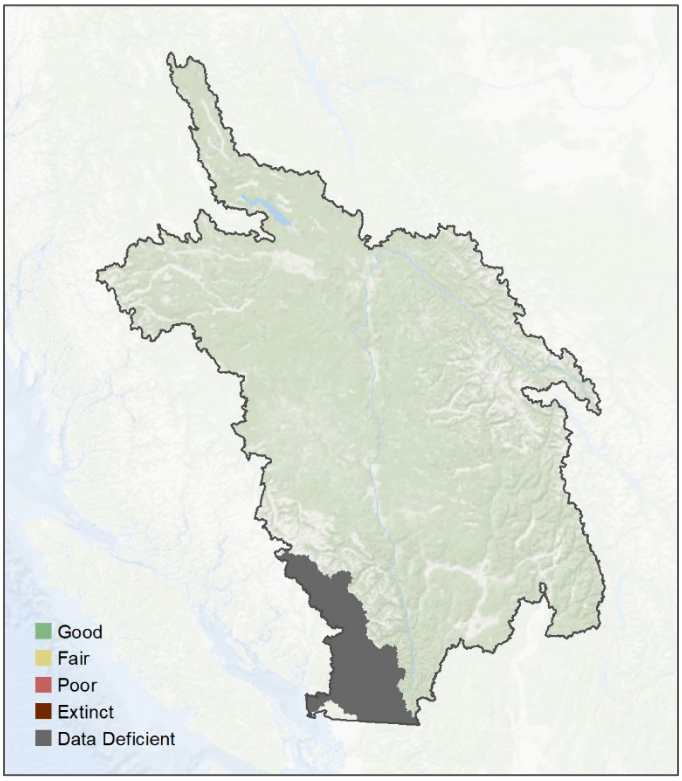

Figure 31. Pacific Salmon Foundation biological status of Fraser chum salmon Conservation Units.

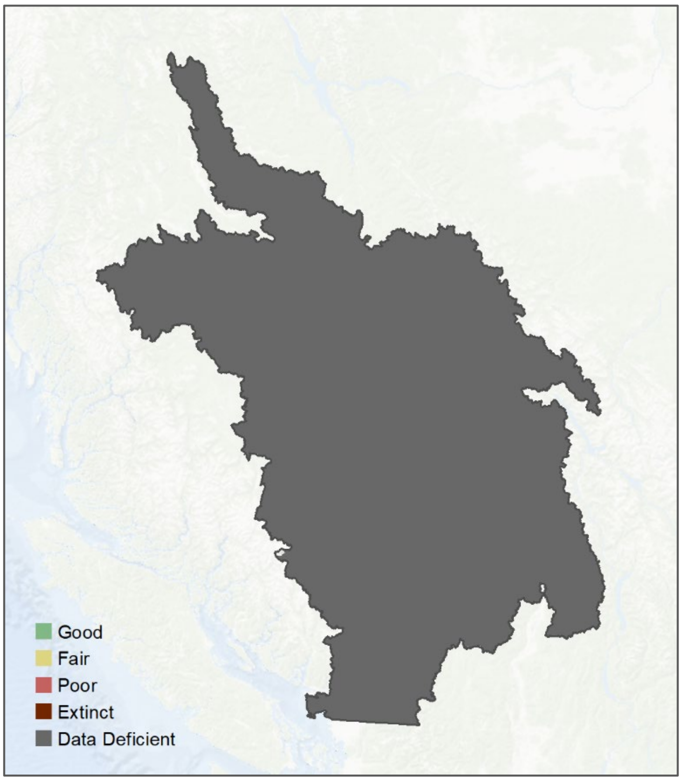

Figure 32. Pacific Salmon Foundation biological status of Fraser coho salmon Conservation Units.

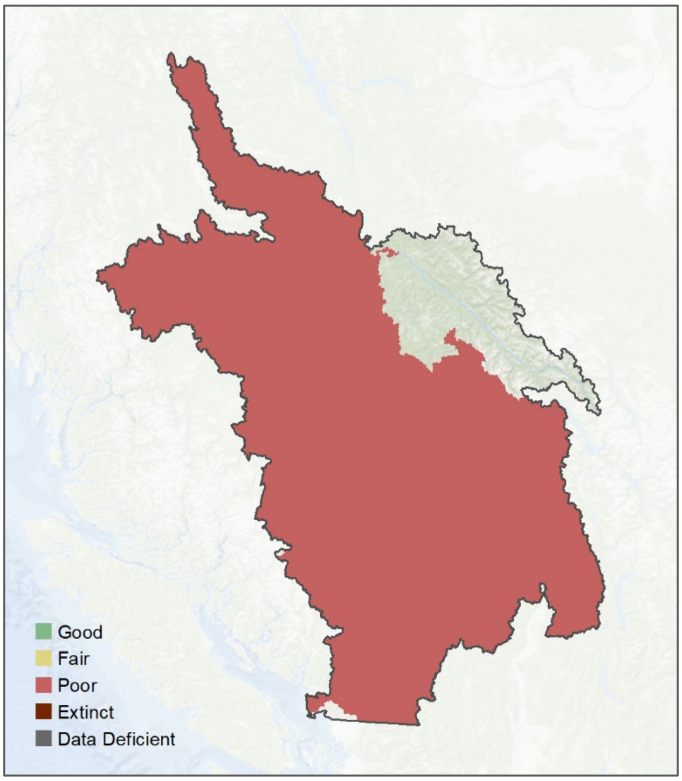

Figure 33. Pacific Salmon Foundation biological status of Fraser pink (odd) salmon Conservation Units.

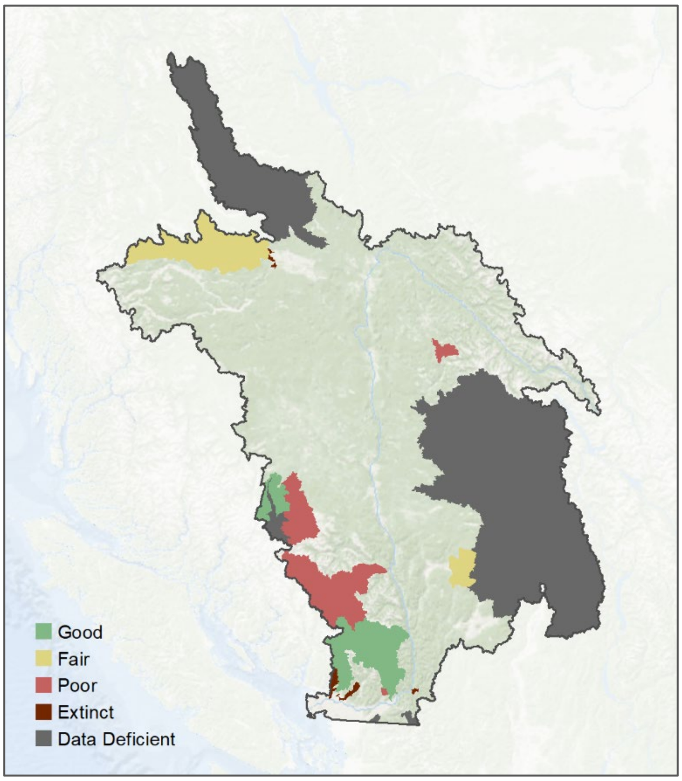

Figure 34. Pacific Salmon Foundation biological status of Fraser sockeye (lake-type) salmon Conservation Units.

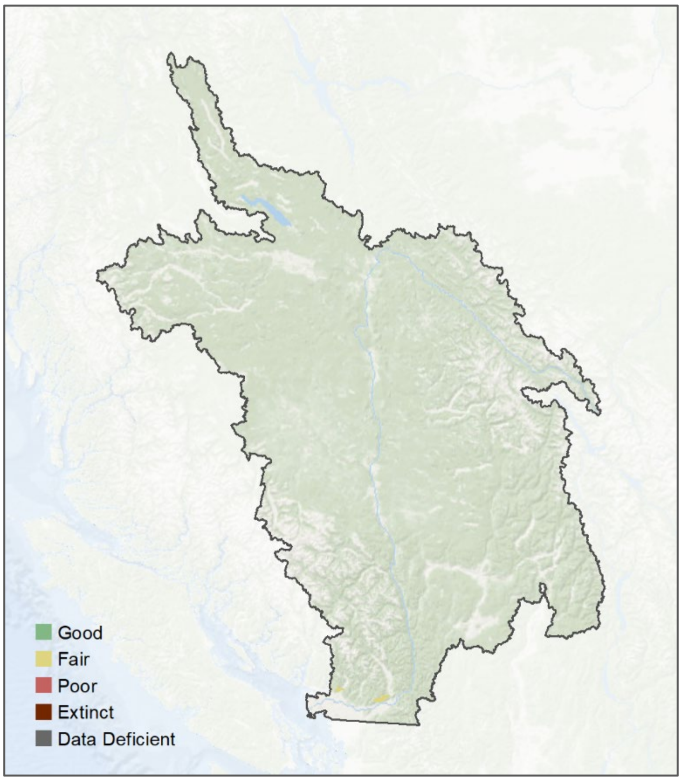

Figure 35. Pacific Salmon Foundation biological status of Fraser sockeye (river-type) salmon Conservation Units.

B: Habitat Status

We completed habitat assessments for watersheds within the 54 salmon CUs in the Fraser Region. The habitat assessments produce two levels of outputs for spawning ZOIs: (1) a risk rating for each FWA assessment watershed in the study area for each individual habitat pressure indicator; (2) a cumulative pressure score for each FWA assessment watershed in the study area, representing the risk to a watershed from all habitat pressures combined. Of the 4,819 1:20K FWA assessment watersheds assessed in the Fraser Region, 45% (n= 2,184) were designated as spawning habitat based on compiled spawning location data. These 2,184 watersheds represent the combined spawning ZOI for all species. In terms of the cumulative pressure scores for the combined spawning ZOI for all species, 42% of spawning habitat in the Fraser Region is high risk (red), 30% is moderate risk (amber), and 28% is low risk (green). The percentage of spawning habitat in each risk category for each indicator is summarized in Table 16 below.

Quantifying both individual and cumulative pressures at the FWA assessment watershed-scale provides a snapshot of habitat pressures across the Fraser Region and highlights which CUs face the greatest risk. Specifically, an overview of habitat pressures emerges from identifying:

1. the percentage area of the combined spawning ZOI for all species that is rated high, moderate, or low risk (i.e. red, amber, green) for each of the evaluated individual habitat pressure indicators; and
2. the percentage area of the combined spawning ZOI for all species that is rated high, moderate, or low risk (i.e. red, amber, green) for cumulative habitat pressures;

More information on habitat pressure benchmark values for each indicator is available in Appendix 12. More information on cumulative spawning Pressure Results by Region and Conservation Unit is available in Appendix 13. Full results are available online through the Pacific Salmon Explorer. The results can be downloaded directly from the Pacific Salmon Explorer for each CU. The datasets compiled for the analysis are also available for download via the Salmon Data Library.

The percentage of area within the Fraser Region's combined spawning ZOI for all species rated high, moderate, or low risk (i.e. red, amber, green) for cumulative pressures and each of the evaluated individual habitat pressure indicators.

Table 16. The percentage of area within the Fraser Region's combined spawning ZOI for all species rated high, moderate, or low risk (i.e. red, amber, green) for cumulative pressures and each of the evaluated individual habitat pressure indicators.

Indicator	% Area of Spawning Habitat		
	High Risk	Moderate Risk	Low Risk
Total Landcover Alteration	18%	28%	54%
Forest Disturbance*	20%	27%	49%
Impervious Surfaces	2%	38%	60%
Mines	21%	0%	79%
Linear Development	25%	24%	52%
Road Development	55%	20%	25%
Stream Crossing Density	3%	70%	26%
Riparian Disturbance	43%	26%	31%
Water Licenses	44%	0%	56%
Waste Water Discharges	10%	0%	90%
Equivalent Clearcut Area	24%	13%	63%
Insect and Disease Defoliation	13%	25%	63%
Cumulative Pressures	42%	30%	28%

* 4% of spawning habitat is data deficient for the forest disturbance indicator

5.5 Vancouver Island & Mainland Inlets Region

Vancouver Island & Mainland Inlets on the Pacific Salmon Explorer includes 86 distinct CUs, including all five species of Pacific salmon. We defined the Vancouver Island & Mainland Inlets Region according to similar criteria used on the Central Coast: geographic proximity to other Regions within the Pacific Salmon Explorer, geographic extent of CUs mainly contained within the Region and FWA Watershed Groups. The resulting Vancouver Island & Mainland Inlets Region (Figure 36) encompasses 76,411 km^2 across Vancouver Island and the adjacent mainland fjords and inlets, from Burrard Inlet and Howe Sound in the south to Smith Inlet and the northern Broughton Archipelago in the north. The process of data gathering, synthesis, outreach, and engagement to complete the initial assessments within the Vancouver Island & Mainland Inlets Region was conducted over two years, from the spring of 2018 to 2020.

For the Vancouver Island & Mainland Inlet Region, we engaged with First Nations, DFO regional biologists and managers, and other salmon experts who provided feedback on the development of the Pacific Salmon Explorer through several localized Technical Meetings. The make-up of stakeholders at these Technical Meetings was based on various geographic and social groupings present across the region. Through the Technical Meeting and engagement process, we received feedback from First Nation aggregate organizations and individual First Nations across the Region, including the Island Marine Aquatic Working Group (IMAWG), A-Tlegay Fisheries Society and member Nations, Nuu-chah-nulth Tribal Council, and Nuu-chah-nulth First Nations, Maa-nulth Treaty Society and member Nations, Q'ul-lhanumutsun Aquatic Resources Society and Cowichan Tribes First Nation, Broughton Aquaculture Transition Initiative and the Namgis First Nation, Musgamagw Dzawada'enuxw Fisheries Group, the Quatsino First Nation, and Kwakiutl First Nation.

The Sakinaw sockeye CU was declared extinct in the wild by DFO as of 2009 (DFO, 2018). However, there is still a population from a captive broodstock program maintaining a hatchery-derived population in Sakinaw Lake. However, since this CU was immediately reintroduced from broodstock from the same CU, it does not meet the criteria for being declared de novo (Wade et al., 2019).

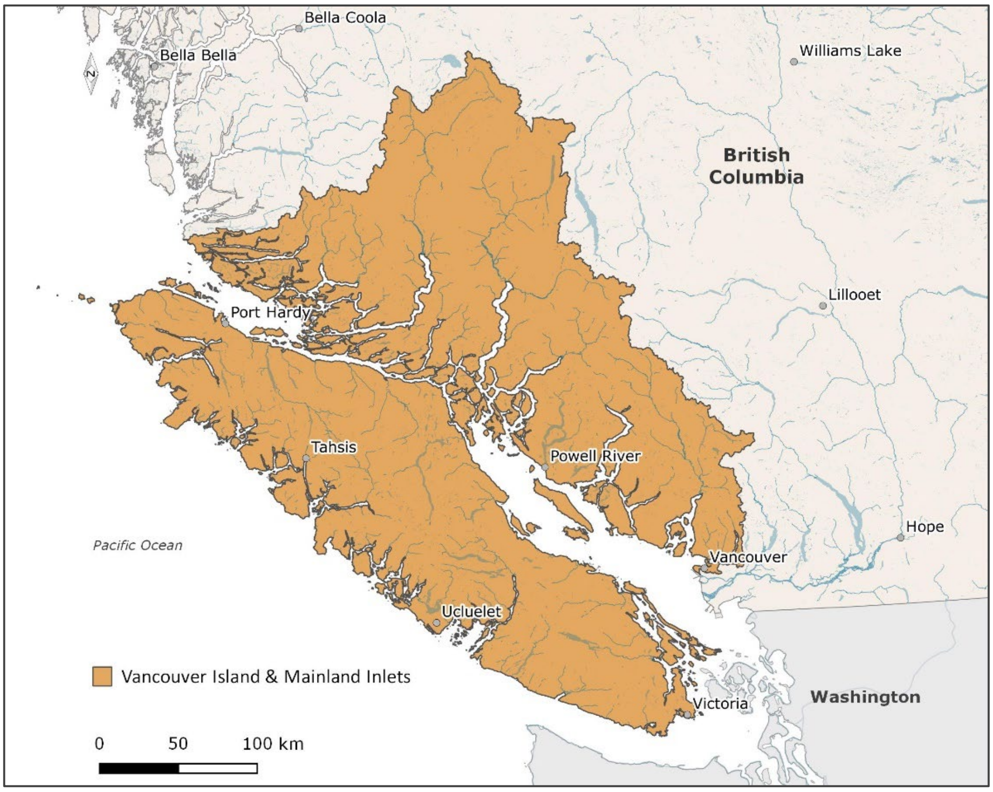

Figure 36. Map of Vancouver Islands & Mainland Inlets Region.

5.5.1 Biological Data and Analytical Methods

In the Vancouver Island & Mainland Inlets Region, we directly accessed datasets for biological indicators from DFO staff. Additional data was sourced from NuSEDS and FOS. Details on specific data sources and analytical methods for the Vancouver Island & Mainland Inlets Region are described below.

A: Spawner Surveys

Spawner survey data for streams in the Vancouver Island & Mainland Inlets Region were sourced from DFO's New Salmon Escapement Database (NuSEDS). For a description of the spawner survey indicator, see Section 4.1.1. Overview of Biological Indicators, A: Spawner Surveys.

B: Spawner Abundance

In the Vancouver Island & Mainland Inlets Region, **observed spawner abundance** is the sum of all spawner survey data documented in NuSEDS, as described in Section 4.1.1. Overview of Biological Indicators, B: Spawner Abundance.

Estimated spawner abundance in the Vancouver Island & Mainland Inlets Region is not available from a centralized database. Thus, estimates of spawner abundance were acquired from specific DFO biologists. For sockeye, estimated spawner abundance for Sproat and Great Central CUs was provided by Diana Dobson (DFO Stock Assessment). The Nimpkish CU was provided by Pieter van Will (DFO Stock Assessment), and the remaining CUs with estimated spawner abundance time series were sourced directly from NuSEDS. For pink salmon, we visualize a dataset acquired from DFO (Pieter van Will). For Chinook, estimated spawner abundance was generated through the Southern BC Chinook Working Group (Brown et al., 2020).

In contrast to estimated spawner abundance values for other species and areas, Vancouver Island & Mainland Inlets Chinook values are only a subset of the entire CU. These subset values are based on the most intensively monitored streams (i.e. there is no expansion made so that the estimated value represents the whole CU). The year at which each estimate spawner abundance time series for Chinook also varies based on the availability and quality of data, with the start year of the time series determined by expert opinion (Brown et al., 2020). For chum, estimated spawner abundance was provided by Diana Dobson (DFO Stock Assessment) based on Holt et al.'s (2018) data. There are no CU-level estimates of spawner abundance for coho salmon in the Vancouver Island & Mainland Inlets Region. Thus, biological status for coho is data deficient for this Region.

C: Run Timing

We currently do not have CU-level **run timing** data for any CUs in the Vancouver Island & Mainland Inlets Region. We will update this information as CU-level run timing data become publicly available. See Section 4.1.1. Overview of Biological Indicators, C: Run Timing for a description of the run timing indicator and methods.

D: Catch & Run Size

Catch and run size data were provided for chum (Diana Dobson, DFO Stock Assessment), pink (Pieter van Will, DFO Stock Assessment), and sockeye (Diana Dobson and Pieter van Will, DFO Stock Assessment) in the Vancouver Island & Mainland Inlets Region. For a description of catch and run size methods, see Section 4.1.1. Overview of Biological Indicators, D: Catch & Run Size.

E: Recruits-per-Spawner

Recruits-per-spawner data were derived by DFO and provided for chum (Diana Dobson, DFO Stock Assessment), pink (Pieter van Will, DFO Stock Assessment), Chinook (Mary Thiess (DFO Stock Assessment), and sockeye (Diana Dobson and Pieter van Will, DFO Stock Assessment) in the Vancouver Island & Mainland Inlets Region. For a description of recruits-per-spawner methods, see Section 4.1.1. Overview of Biological Indicators, E: Recruits-per-Spawner.

F: Trends in Spawner Abundance

Trends in spawner abundance were derived for chum (Diana Dobson, DFO Stock Assessment), pink (Pieter van Will, DFO Stock Assessment), and sockeye (Diana Dobson and Pieter van Will, DFO Stock Assessment) in the Vancouver Island & Mainland Inlets Region. For a description of trends in spawner abundance methods, see Section 4.1.1. Overview of Biological Indicators, F: Trends in Spawner Abundance.

G: Juvenile Surveys

We acquired multiple sources' **smolt abundance** data for several CUs in the Vancouver Island & Mainland Inlets Region. Smolt abundance data for streams within the East Vancouver Island-Georgia Strait coho CU were provided by Jim Meldrum (A-Tlegay Fisheries Society) and Karalea Cantera (DFO, Fish and Fish Habitat Protection Program). Smolt abundance data for streams within the Georgia Strait chum, East Vancouver Island-North (Fall 0.x), Chinook, and Georgia Strait pink (odd) CUs were provided by Jim Meldrum (A-Tlegay Fisheries Society). Smolt abundance data for streams within the West Vancouver Island-South (Fall 0.x) Chinook CU were provided by Bob Bocking (Maa-nulth Treaty Society) and Jared Dick (Nuu-chah-nulth Tribal Council). Smolt abundance data for streams within the West Vancouver Island coho CU were provided by Roger Dunlop (Nuu-chah-nulth Tribal Council), Karalea Cantera (DFO, Fish and Fish Habitat Protection Program), and sourced from Wade and Irvine (2018; DFO). Smolt abundance data for the Great Central Lake sockeye, Sproat Lake sockeye), and Henderson Lake sockeye CUs were provided by Graham Murrell (Nuu-chah-nulth Tribal Council). Smolt abundance data for the Nahwitti Lowland coho CU were provided by Trevor Davies (Provincial Ministry of Forests, Lands, Natural Resource Operations & Rural Development) and sourced from Wade and Irvine (2018; DFO). Smolt abundance data for streams within the East Vancouver Island-Georgia Strait coho and Georgia Strait Mainland coho CUs were provided by Karalea Cantera (DFO, Fish and Fish Habitat Protection Program) and sourced from Wade and Irvine (2018; DFO). Smolt abundance data for the Sakinaw Lake sockeye CU were provided by Karalea Cantera (DFO, Fish and Fish Habitat Protection Program). Smolt abundance data for streams within the Juan de Fuca-Pachena coho CU were sourced from Wade and Irvine (2018; DFO). For a description of juvenile survey methods, see Section 4.1: Overview of Biological Indicators, G: Juvenile Surveys.

H: Hatchery Releases

Hatchery releases in the Vancouver Island & Mainland Inlets Region for all species were provided by DFO (Joan Bateman, Salmonid Enhancement Program). Refer to Section 4.1.1. Overview of Biological Indicators, H: Hatchery Releases for details on data and analytical methods.

I: Biological Status

Nuances regarding biological status assessments for Vancouver Island & Mainland Inlets CUs are listed below. See Sections 4.1.4. Benchmarks for Assessing Biological Status and 4.1.5. Decision Rules for Assessing Biological Status for more details on biological status assessment methods.

i: Southern BC Chinook CUs

For 14 Southern BC Chinook CUs in the Vancouver Island & Mainland Inlets Region, we only visualize **biological status** as assessed in the most recent Wild Salmon Policy report (DFO, 2018) and COSEWIC status assessments (COSEWIC, 2018) for several reasons (Brown et al., 2020). First, there are no CU-level spawner-recruitment data available for these CUs. Thus, we cannot apply our spawner-recruitment benchmarks to assess status (see Section 4.1.5. Decision Rules for Assessing Biological Status). In addition, these CUs exhibit low productivity (<1.5%) and a relatively high exploitation rate (>40%). As a result, it is inappropriate to our percentile benchmarks because it has been shown to potentially result in status assessments that are not precautionary (Holt et al., 2018). Therefore, the WSP and COSEWIC approaches apply to these CUs because they apply multiple metrics and expert judgment to assess status.

5.5.2 Habitat Data and Analytical Methods

Nuances regarding habitat pressure indicator data and analytical methods for the Vancouver Island & Mainland Inlets Region are listed below. Refer to Section 4.2 Indicators and Benchmarks for Assessing Habitat Status for information on habitat pressure indicators, benchmarks, and the analytical methods used to assess habitat status. Additional details on habitat pressure indicators, data sources, data currency, and benchmarks specific to the Vancouver Island & Mainland Inlet Region are available in Appendix 6 (Description of Habitat Pressure Indicators & Relevance to Salmon), Appendix 7 (Habitat Pressure Datasets & Data Sources), Appendix 8 (Spatial Data Processing for Habitat Pressure Indicators), Appendix 9 (Spatial Data Processing for Future Pressures), and Appendix 12 (Habitat Pressure Benchmark Values by Region).

A: Transboundary Conservation Units

The pink (odd-year) Homathko-Klinaklini-Smith-Rivers-Bella Coola-Dean CU spans the boundary between the Central Coast and Vancouver Island & Mainland Inlets regions. For habitat indicators that used relative benchmarks, habitat status for this transboundary conservation unit was assessed based on benchmarks derived from the Central Coast region because a significant portion of spawning habitat for this conservation unit fell inside the Central Coast region.

B: Spawning Zones of Influence

Methods for delineating Chinook CU **spawning zones of influence (ZOIs)** vary by region in accordance with the CU delineation approach used by DFO. In the Fraser and Vancouver Island and Mainland Inlet regions, Chinook CUs are more broadly defined geographically, which meant that the methods employed for determining pink, chum, and coho spawning ZOIs were also applicable to Chinook CUs. The localized spawning ZOI for each VIMI Chinook CU was delineated by capturing the extent of all 1:20K FWA assessment watersheds that directly intersect with known spawning locations for Chinook.

C: Forest Disturbance on Southeast Vancouver Island

A large portion of southeast Vancouver Island is privately managed forests. As such, forest disturbance data sourced from DataBC in this area is either incomplete or not up to date. Efforts were made to source the best available data on forest disturbance for these privately managed forests, but we could not access this data. We defined a "Data Deficient" status for the forest disturbance indicator to overcome this challenge. The data deficient status was assigned for any watershed that was >= 50% privately owned forest. The exception was that if a watershed was high risk for forest disturbance based on the publicly available forest disturbance data, then that high-risk status was maintained and reported.

D: Additional Spawning Habitat Information Sources

In addition to the spawning habitat information we acquired from the Fisheries Information Summary System (FISS) database and local knowledge derived through expert elicitation, we received additional spawning habitat information from a technical report provided by Graham Murrell (Fisheries Manager, Hupacasath First Nation; Wright, 2008).

5.5.3 Results

A: Biological Status

This section provides a high-level overview of the biological status results for all 86 salmon CUs in the Vancouver Island & Mainland Inlet Region. Of the 86 CUs we examined in the Region, we were able to assess biological status for 18 CUs (21%). The remaining 68 salmon CUs (79%) had insufficient information for evaluating their biological status (see Section 4.1.5 Decision Rules for Assessing Biological Status for the criteria used to define data deficient CUs). Of the CUs for which we were able to assess biological status, 12 (67%) of CUs are in the green status zone, 3 (17%) are in the amber zone, and 3 (17%) are in the red status zone. Biological status for all CUs is displayed by species in Figures 37-43 below. More information on biological status and benchmarks for each CU is available in Table A.11 in Appendix 4. Full results are available online through the Pacific Salmon Explorer, where individual figures, maps, data, and summary statistics are provided for each CU in the Region. The results of these assessments reflect data that are current to 2018. As new data becomes available, we will update the analyses and results in this report and on the Pacific Salmon Explorer.

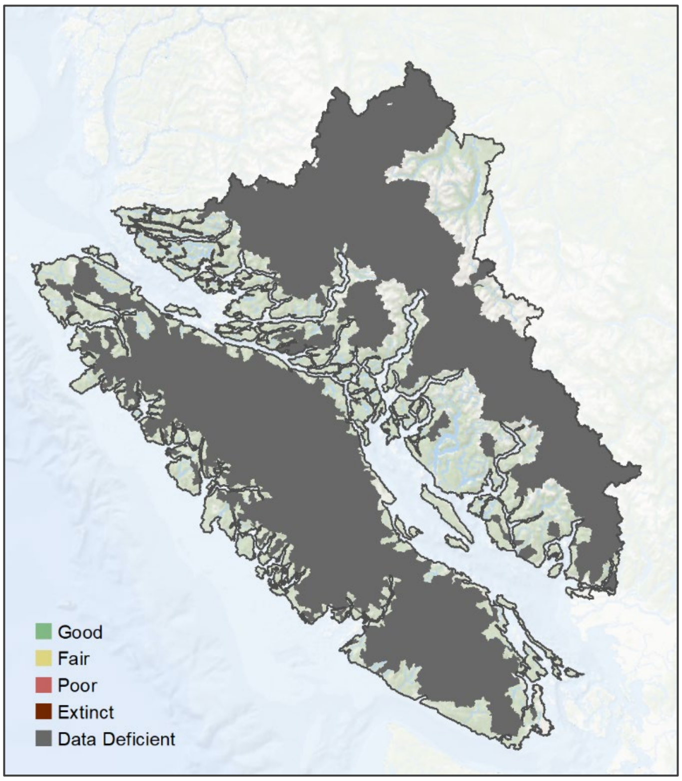

Figure 37. Pacific Salmon Foundation biological status of Vancouver Island & Mainland Inlets Chinook salmon Conservation Units.

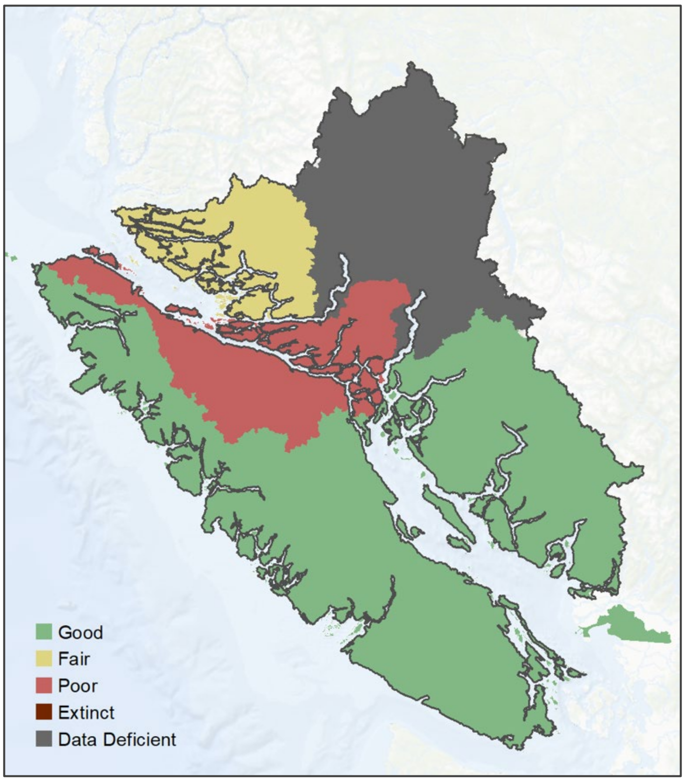

Figure 38. Pacific Salmon Foundation biological status of Vancouver Island & Mainland Inlets chum salmon Conservation Units.

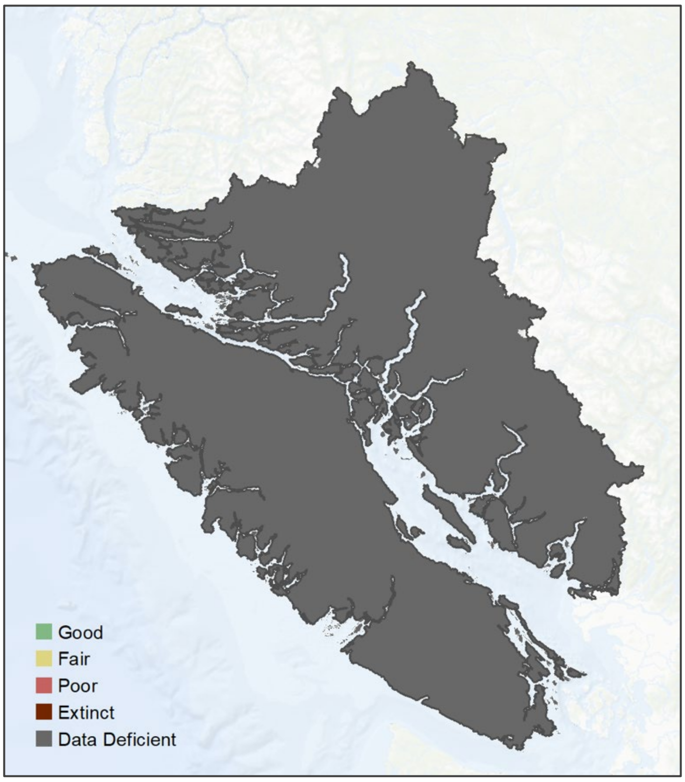

Figure 39. Pacific Salmon Foundation biological status of Vancouver Island & Mainland Inlets coho salmon Conservation Units.

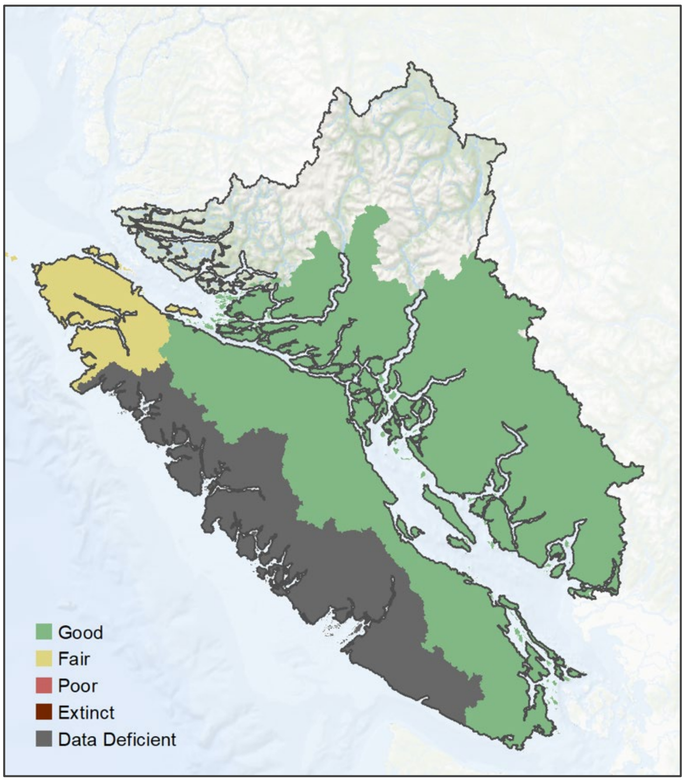

Figure 40. Pacific Salmon Foundation biological status of Vancouver Island & Mainland Inlets pink (odd) salmon Conservation Units.

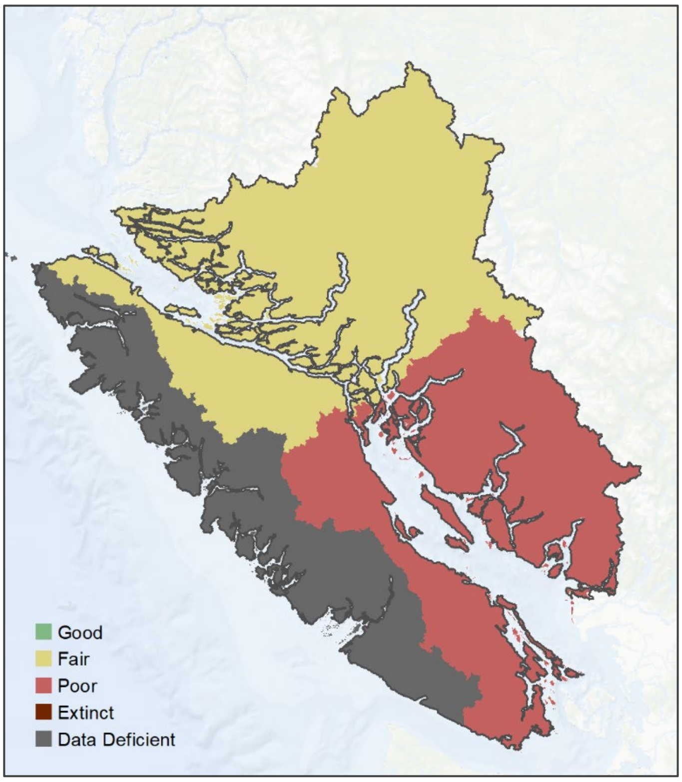

Figure 41. Pacific Salmon Foundation biological status of Vancouver Island & Mainland Inlets pink (even) salmon Conservation Units.

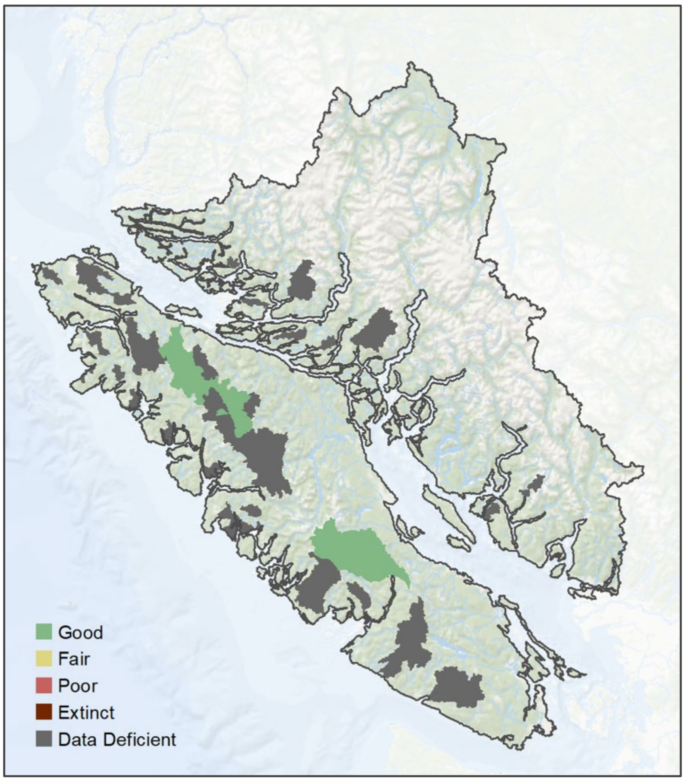

Figure 42. Pacific Salmon Foundation biological status of Vancouver Island & Mainland Inlets sockeye (lake-type) salmon Conservation Units.

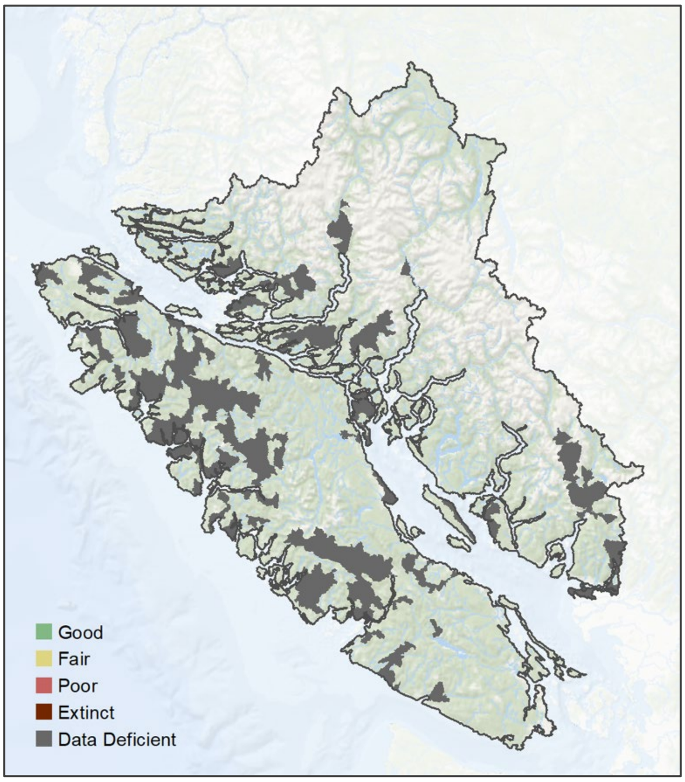

Figure 43. Pacific Salmon Foundation biological status of Vancouver Island & Mainland Inlets sockeye (river-type) salmon Conservation Units.

B: Habitat Status

We completed habitat assessments for watersheds within the 87 salmon CUs in the Vancouver Island & Mainland Inlets Region. The habitat assessments produce two levels of outputs for spawning ZOIs: (1) a risk rating for each FWA assessment watershed in the study area for each individual habitat pressure indicator; (2) a cumulative pressure score for each FWA assessment watershed in the study area, representing the risk to a watershed from all habitat pressures combined. Of the 1,539 1:20K, FWA assessment watersheds assessed in the Vancouver Island & Mainland Inlets Region, 56% (n= 864) were designated spawning habitat based on compiled spawning location data. These 864 watersheds represent the combined spawning ZOI for all species. In terms of the cumulative pressure scores for the combined spawning ZOI for all species, 42% of spawning habitat in the Vancouver Island & Mainland Inlets Region is high risk (red), 36% is moderate risk (amber), and 22% is low risk (green). The percentage of spawning habitat in each risk category for each indicator is summarized in Table 17 below.

Quantifying both individual and cumulative pressures at the FWA assessment watershed-scale provides a snapshot of habitat pressures across the Vancouver Island & Mainland Inlets Re and highlights which CUs face the greatest risk. Specifically, an overview of habitat pressures emerges from identifying:

1) the percentage area of the combined spawning ZOI for all species that is rated high, moderate, or low risk (i.e. red, amber, green) for each of the evaluated individual habitat pressure indicators; and
2) the percentage area of the combined spawning ZOI for all species that is rated high, moderate, or low risk (i.e. red, amber, green) for cumulative habitat pressures;

More information on habitat pressure benchmark values for each indicator is available in Appendix 12. More information on cumulative spawning Pressure Results by Region and Conservation Unit is available in Appendix 13. Full results are available online through the Pacific Salmon Explorer. The results can be downloaded directly from the Pacific Salmon Explorer for each CU. The datasets compiled for the analysis are also available for download via the Salmon Data Library.

Table 17. The percentage of the area within the Vancouver Island & Mainland Inlets Region's combined spawning ZOI for all species rated high, moderate, or low risk (i.e. red, amber, green) for cumulative pressures and each of the evaluated individual habitat pressure indicators.

Indicator	% Area of Spawning Habitat		
	High Risk	Moderate Risk	Low Risk
Total Landcover Alteration	32%	32%	36%
Forest Disturbance*	31%	28%	24%
Impervious Surfaces	5%	44%	50%
Mines	24%	0%	76%
Linear Development	33%	32%	34%
Road Development	61%	19%	20%
Stream Crossing Density	4%	79%	16%
Riparian Disturbance	31%	41%	29%
Water Licenses	42%	0%	58%
Waste Water Discharges	13%	0%	87%
Equivalent Clearcut Area	11%	13%	76%
Insect and Disease Defoliation	3%	0%	97%
Cumulative Pressures	42%	36%	22%

* 17% of spawning habitat is data deficient for the forest disturbance indicator

5.6 Haida Gwaii Region

The archipelago of Haida Gwaii is located off the North Central Coast of BC (Figure 44), composed of two main islands; Graham Island (northern) and Moresby Island (southern), with hundreds of other smaller islands in total composing nearly 10,000 square kilometers. The Hecate Strait separates Haida Gwaii from mainland British Columbia by about 100 kilometers. Salmon-bearing waters on Haida Gwaii range from an abundance of small streams along the many kilometers of coastline to larger well-known salmon rivers such as the Yakoun and Tlell Rivers. All five species of Pacific salmon spawn and rear on Haida Gwaii within 29 salmon CUs. These CUs include: 2 Chinook, 5 chum, 3 coho, 3 pink (even-year), 3 pink (odd-year), 10 sockeye (lake-type), and 3 sockeye (river-type). The process of data gathering and synthesis to complete the initial assessments within the Haida Gwaii Region was completed over one year (2021).

In order to develop the Pacific Salmon Explorer for Haida Gwaii, we engaged with the Haida Nation, DFO, the Gowgaia Institute, Parks Canada, and other salmon experts in Haida Gwaii. We received input and feedback throughout the engagement processes, which included an in-person meeting in September 2021, meeting follow-up, and extended outreach.

Based on feedback and local knowledge, we received contextual knowledge on salmon populations within the region, described within Biological Data and Analytical methods, and were able to improve upon forestry data with contributions from the Gowgaia Institute (described in Section 5.5.2 Habitat Data and Analytical Methods).

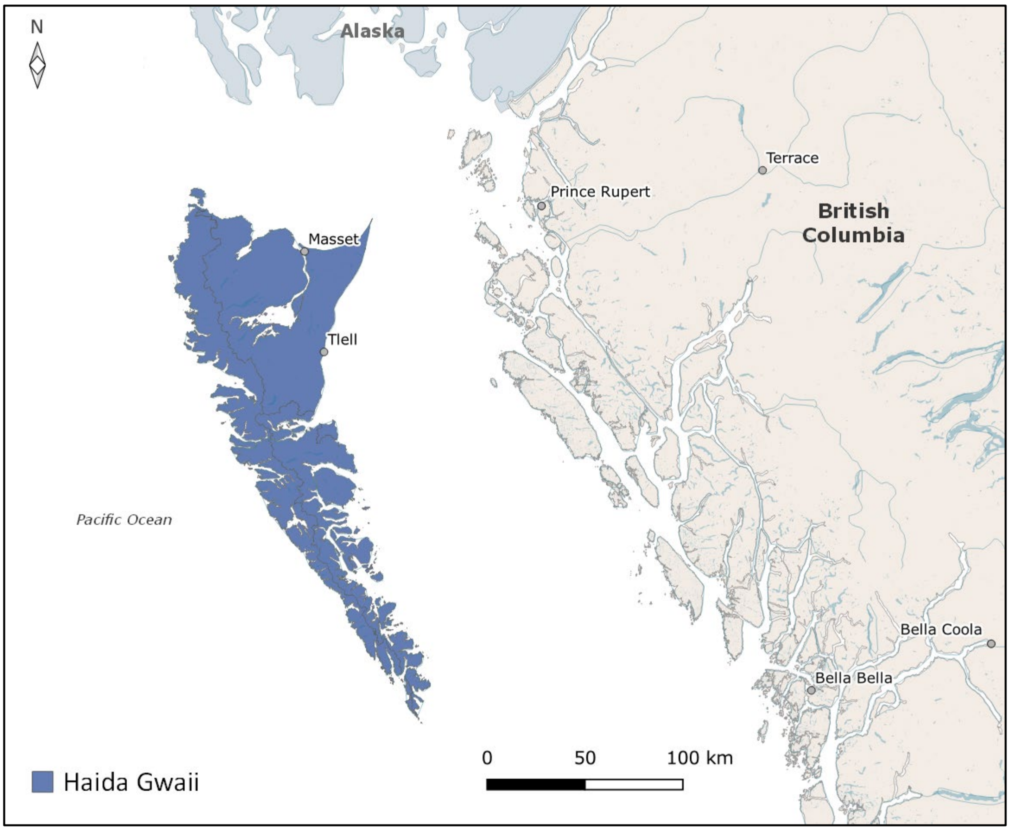

Figure 44. Map of the Haida Gwaii Region.

5.6.1 Biological Data and Analytical Methods

As with the Skeena and Nass regions, in the Haida Gwaii Region many of the datasets necessary to understand the dynamics of salmon CUs have been compiled and stored through the North and Central Coast (NCC) Database (English et al., 2018; see Skeena Region). Details on specific data sources, analytical methods, and nuances specific to the Haida Gwaii Region are described below.

A: Spawner Surveys

Spawner survey data for streams in the Haida Gwaii Region were sourced from DFO's New Salmon Escapement Database (NuSEDS). For a description of the spawner survey indicator, see Section 4.1.1. Overview of Biological Indicators, A: Spawner Surveys.

B: Spawner Abundance

Observed spawner abundance for CUs on the in the Haida Gwaii Region is the sum of all spawner survey data as documented in NuSEDS, as described in Section 4.1.1. Overview of Biological Indicators, B: Spawner Abundance. Similar to our work in other adjacent regions (Central Coast, Skeena, Nass), we accessed most of these datasets via the North and Central Coast (NCC) database, maintained by LGL Ltd. (English et al., 2018).

Haida Gwaii CU-level **estimates of spawner abundance** (run reconstructions) were sourced from the North and Central Coast (NCC) database. Haida Gwaii CU-level estimated spawner abundance time series were developed for the NCC database according to the expansion factors described in the Skeena Region section above. At time of publication, the data is current to 2017. On Haida Gwaii, the decline in monitoring coverage over the last 10-20 years was mentioned as an area of concern, and a decline in assessments may affect the relationships used to develop total estimates of spawner abundance (run reconstructions), as described in Section 4.1.3 Data Quality.

C: Run Timing

We currently do not have CU-level **run timing** data for any CUs in the Haida Gwaii Region. We will update this information as CU-level run timing data become publicly available. See Section 4.1.1. Overview of Biological Indicators, C: Run Timing for a description of the run timing indicator and methods.

D: Catch & Run Size

Catch and run size, and subsequent exploitation rates for CUs on the Haida Gwaii Region were calculated by DFO and LGL from data in the Fisheries Operating System (FOS) and other DFO databases. Similar to our work in other adjacent regions (Central Coast, Skeena, Nass), we accessed most of these datasets via the North and Central Coast (NCC) database, maintained by LGL Ltd. (English et al., 2018). At time of publication, the data is current to 2017. For a description of catch and run size methods, see Section 4.1.1. Overview of Biological Indicators, D: Catch & Run Size.

On Haida Gwaii, there are some specific nuances to catch data that are important to be aware of when considering the role of catch in estimates of total annual salmon run size. For sockeye salmon, the catch is calculated from a fixed estimate of an annual exploitation rate of 20%. Local knowledge suggests this value may be high, but the representativeness of a fixed rate is less likely to capture annual differences. There is only one Coded Wire Tag indicator stock for coho salmon, so these values are applied to all other coho when used in catch calculations. These considerations in estimates of catch are discussed in Section 4.1.3 Data Quality.

E: Recruits-per-Spawner

Recruits-per-spawner data for CUs in the Haida Gwaii Region were derived from the DFO age database and CU-level estimates of spawner abundance and catch and run size accessed from the North and Central Coast (NCC) database

(English et al., 2018). For a description of recruits-per-spawner methods, see Section 4.1.1. Overview of Biological Indicators, E: Recruits-per-Spawner.

F: Trends in Spawner Abundance

Trends in spawner abundance for CUs on Haida Gwaii were derived from the CU-level estimates of spawner abundance accessed from the North and Central Coast (NCC) database (English et al. 2018). For a description of trends in spawner abundance methods, see Section 4.1.1. Overview of Biological Indicators, F: Trends in Spawner Abundance.

G: Juvenile Surveys

Juvenile abundance data for CUs in the Haida Gwaii were available from Haida Fisheries for a coho smolt outmigration program at Deena River in the East Haida Gwaii coho CU. We will update this information as other juvenile data becomes available. For a description of the juvenile surveys indicator, see Section 4.1.1. Overview of Biological Indicators, G: Juvenile Surveys.

H: Hatchery Releases

Hatchery releases in the Haida Gwaii Region for all species were provided by DFO (Joan Bateman, Salmonid Enhancement Program). Refer to Section 4.1.1. Overview of Biological Indicators, H: Hatchery Releases for details on data and analytical methods.

I: Biological Status

The **biological status** assessments for CUs in the Haida Gwaii Region currently reflect data sourced from the North and Central Coast (NCC) database that are current to 2017. As new data become available, we will update the analyses and results in this report as well as on the Pacific Salmon Explorer. See Sections 4.1.4. Benchmarks for Assessing Biological Status and 4.1.5. Decision Rules for Assessing Biological Status for more details on biological status assessment methods.

Local knowledge suggests that some CU statuses might be biased high compared to current abundance, as the data is only current to 2017. This was particularly discussed for coho – of all spawner surveys on Haida Gwaii, the ratio of indicator: non-indicator streams are the lowest for coho, so expansions to determine CU levels of escapement undergo increased undertenancy. Coho is prevalent in many of Haida Gwaii's watercourses, so attempting CU level estimates of spawners is inherently challenging.

5.6.2 Habitat Data and Analytical Methods

Nuances regarding habitat pressure indicator data and analytical methods for the Haida Gwaii Region are listed below. Refer to Section 4.2 Indicators and

Benchmarks for Assessing Habitat Status for information on habitat pressure indicators, benchmarks, and the analytical methods used to assess habitat status. Additional details on habitat pressure indicators, data sources, data currency, and benchmarks specific to the Haida Gwaii Region are available in Appendix 6 (Description of Habitat Pressure Indicators & Relevance to Salmon), Appendix 7 (Habitat Pressure Datasets & Data Sources), Appendix 8 (Spatial Data Processing for Habitat Pressure Indicators), Appendix 9 (Spatial Data Processing for Future Pressures), and Appendix 12 (Habitat Pressure Benchmark Values by Region).

A: Spawning Zones of Influence

Methods for delineating Chinook CU **spawning zones of influence (ZOIs)** vary by region in accordance with the CU delineation approach used by DFO. In the Skeena, Nass, Central Coast, and Haida Gwaii regions, Chinook CUs are defined using a more restrictive geographic representation, which resulted in fewer (or no) spawning locations occurring within the CU boundaries. As such, spawning ZOIs for each Chinook CU were delineated using the extent of all 1:20K FWA Assessment Watersheds that directly intersected with Haida Gwaii Chinook CU boundaries.

B: Marian/Eden Conservation Unit Boundary

Based on feedback from the Haida Gwaii Technical Working Group, the name of the Marian Lake sockeye conservation unit was renamed to "Marian/Eden." The original name developed by DFO (Holtby and Ciruna, 2007) and in DFO's New Salmon Escapement Database was "Marian" however, TWG members indicated that most of the salmon and surveys are in Eden Lake, and a recent DFO IFMP for Northern Salmon listed "Marian/Eden" rather than "Marian" (DFO, 2019). Additionally, while defined by Holtby and Ciruna (2007) as a conservation unit, DFO did not have a conservation unit boundary defined for this CU. We defined the CU boundary as the same spatial extent as the spawning habitat for Marian Lake (which encompasses the watersheds that contain Marian Lake, Eden Lake, and Roy Lake).

C: Spatial Data Processing for Habitat Pressure Indicators

i: Forest Disturbance on Haida Gwaii

Working with John Broadhead and Dave Leversee of the Gowgaia Institute, we accessed the best available logging history (harvested areas) dataset compiled for Haida Gwaii. The Gowgaia Institute produced this logging history dataset as part of the Riparian Fish Forest on Haida Gwaii project (Broadhead 2009), and they updated this dataset to 2021. The Gowgaia dataset provided a more complete representation of forest disturbance on Haida Gwaii than was available in the VRI and Consolidated Cutblocks datasets that we used to assess forest disturbance in other regions to date. The spatial data processing method for forest disturbance on Haida Gwaii was updated to source the Gowgaia dataset (Appendix 8).

With their expert knowledge of logging history on Haida Gwaii, the Gowgaia Institute also identified areas where assessing risk at the assessment watershed scale may over or underrepresent more localized risk. Categorizing risk at the assessment watershed-scale generalizes risk across watersheds. As such, at this scale, it is not possible to identify whether risk is evenly distributed across a watershed or is more concentrated in certain parts of a watershed. Areas that the Gowgaia Institute identified as suffering from this limitation were Haines Creek and watersheds on NE Graham Island, where much of these areas are unimpacted by harvesting; they were categorized as moderate risk due harvesting that occurred in concentrated areas of these watersheds.

ii: Total Land Cover Alteration on Haida Gwaii

The spatial data processing method for total land cover alteration on Haida Gwaii used newly available data sources from the Province of BC's Cumulative Effects Framework (BC CEF) team as well as the logging history (harvested areas) dataset from Gowgaia Institute. BC CEF's Human Disturbance with Base Thematic Mapping (2021) dataset was used as the data source for polygons representing the following disturbance types: mountain pine beetle (not present on Haida Gwaii), railway and airports, recreation, transmission lines, major rights of ways, mining, oil & gas infrastructure, seismic infrastructure (not present on Haida Gwaii), agriculture and urban areas. BC CEF's Integrated Roads (2021) dataset was used as the data source for roads which were then buffered as outlined for processing the road development indicator (Appendix 8).

iii: Riparian Disturbance on Haida Gwaii

The riparian disturbance indicator used the total land cover alteration layer as an input data layer. As such, the spatial data processing methods used newly available data sources from the Province of BC's Cumulative Effects Framework (BC CEF) team as well as the logging history (harvested areas) dataset from Gowgaia Institute (Appendix 8).

iv: Road Development on Haida Gwaii

The spatial data processing method for road development on Haida Gwaii used the newly available Integrated Roads (2021) dataset from the Province of BC's Cumulative Effects Framework team (Appendix 8).

v: Linear Development on Haida Gwaii

The spatial data processing method for linear development on Haida Gwaii used the newly available Integrated Roads (2021) dataset from the Province of BC's Cumulative Effects Framework team (Appendix 8).

vi: Equivalent Clearcut Area on Haida Gwaii

The spatial data processing method for calculating equivalent clearcut area (ECA) used the total land cover alteration layer as an input data layer. As such, the spatial data processing methods used newly available data sources from the Province of BC's Cumulative Effects Framework (BC CEF) team as well as the logging history (harvested areas) dataset from Gowgaia Institute (Appendix 8). Specifically, BC CEF's Human Disturbance with Base Thematic Mapping (2021) dataset was used as the data source for polygons representing the following disturbance types: mountain pine beetle (not present on Haida Gwaii), railway and airports, transmission lines, major rights of ways, mining, oil & gas infrastructure, seismic infrastructure (not present on Haida Gwaii), agriculture and urban areas. BC CEF's Integrated Roads dataset was used as the data source for roads which were then buffered as outlined for processing the road development indicator (Table A.18; Appendix 8). Fire polygons were sourced from the Current Fire Perimeters and Historical Fire Perimeters datasets available on DataBC. Harvested areas were sourced from the Vegetation Resources Inventory (VRI) database available on DataBC and supplemented with Gowgaia Institute's logging disturbance dataset for harvested areas not captured in the VRI dataset.

ECA disturbance types were identified as "recoverable" and "non-recoverable." Non-recoverable disturbance types are those where the land disturbance is considered permanent and recorded as 100% ECA. Non-recoverable disturbance types include railway and airports, transmission lines, major rights of ways, mining, oil & gas infrastructure, seismic infrastructure (not present on Haida Gwaii), agriculture, and urban areas. Recoverable disturbance types, where the hydrologic function of the landscape is expected to recover over time (i.e. second-growth forest), include harvested areas, burned areas, and areas impacted by mountain pine beetle (not present on Haida Gwaii). ECA recovery curves identify a recovery factor based on stand height. Projected stand height is sourced from the VRI dataset. ECA recovery curves were updated in 2019 to differentiate recovery rates for interior and coastal forests (FREP 2019).

A "non-recoverable" layer was created by first merging and dissolving all non-recoverable disturbance types. Harvested and burned area polygons were dissolved based on projected stand height and then merged with the non-recoverable layer. Lastly, harvested area and burned area polygons without stand height but with a date of disturbance were dissolved based on time since disturbance (years) and merged with the non-recoverable and recoverable polygons with stand height. This combined ECA layer was overlaid with the FWA assessment watersheds. The growth recovery of each polygon was calculated based on stand height using the coastal recovery curve or using a time since disturbance surrogate method where stand height information was not readily available. The growth recovery of each recoverable polygon with stand height information was calculated using the following equation:

$$ECA = A*C(1-R/100)$$

where A is the original polygon area, C is the proportion of the opening covered by functional regeneration (determined from Table A2.1, MOF, 2001), and R is the recovery factor (for coastal forests from Hudson, R., and G. Horel, 2007 and from Winkler, R., and S. Boon, 2015 for interior forests). For non-recoverable polygons, there is no functional regeneration or recovery factor, so for these polygons, C will be equal to 1, and R will be equal to 0. Where stand height is not available (e.g. for harvested areas sourced from the Gowgaia Institute) a time since disturbance surrogate was used to estimate ECA: 1-10 yrs = 100% ECA, 11-20 = 75%, 21-40 = 25% and 40-50 yrs = 5%, >50 years = 0%[1]. ECA was summed for each FWA watershed then divided by the total watershed area to give an ECA percentage for each watershed.

D: Spawning Habitat Information from Expert Knowledge Holders

In addition to the spawning habitat information we acquired from DataBC (primarily from the Fisheries Information Summary System (FISS) database), we collaborated with representatives from Haida Fisheries, Fisheries and Oceans Canada's Salmon Enhancement Program, Parks Canada, the Gowgaia Institute, the Hecate Strait Streamkeepers, and independent salmon experts to identify local salmon spawning locations. The collective identified 16 new salmon-bearing watersheds that had not been previously documented, further enhancing the baseline of available information for Haida Gwaii salmon.

5.6.3 Results

A: Biological Status

This section provides a high-level overview of the biological status results for the 29 salmon CUs in the Haida Gwaii Region. Of the 29 CUs we examined in the Region, we were able to assess biological status for 16 CUs (55%). The remaining 13 salmon CUs (45%) had insufficient information for evaluating their biological status (see Section 4.1.5 Decision Rules for Assessing Biological Status for the criteria used to define data deficient CUs). Of the CUs for which we were able to assess biological status, 9 (56%) of CUs are in the green status zone, 4

[1] BC Cumulative Effects Framework (BC CEF) ECA method includes an additional step to approximate stand height where not available in VRI before defaulting to this time since disturbance surrogate ECA estimate. This data was not available to us at the time of our assessments but our upcoming work to revise our habitat indicator methods will aim to source ECA directly from BC CEF or to update our methods to fill stand height data gaps where possible.

(25%) are in the amber zone, and 3 (19%) are in the red status zone. Biological status for each CU is displayed by species in Figures 45-53 below.

More information on biological status and benchmarks for each CU is available in Table A.12 in Appendix 4. Full results are available online through the Pacific Salmon Explorer, where individual figures, maps, data, and summary statistics are provided for each CU in the Region. The results of these assessments reflect data that are current to 2017. As new data become available, we will update the analyses and results in this report and on the Pacific Salmon Explorer.

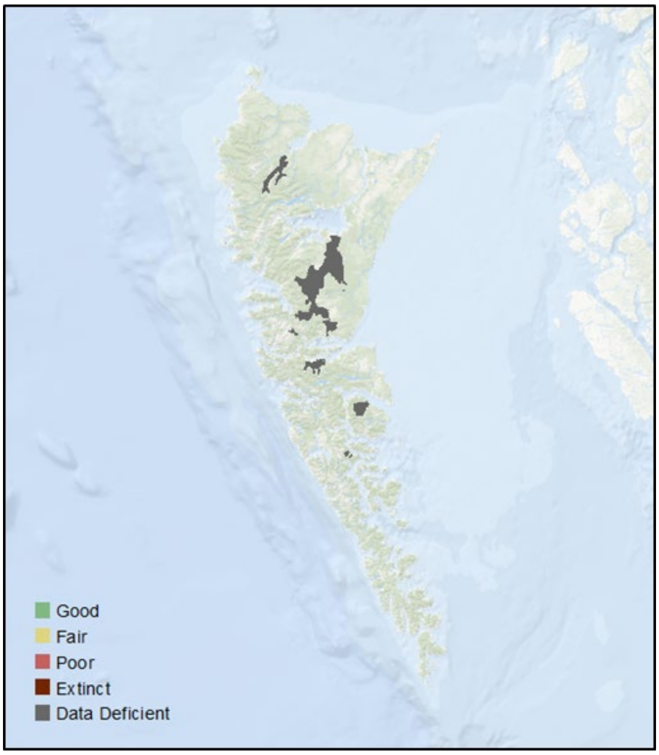

Figure 45. Pacific Salmon Foundation biological status of Haida Gwaii Chinook salmon Conservation Units.

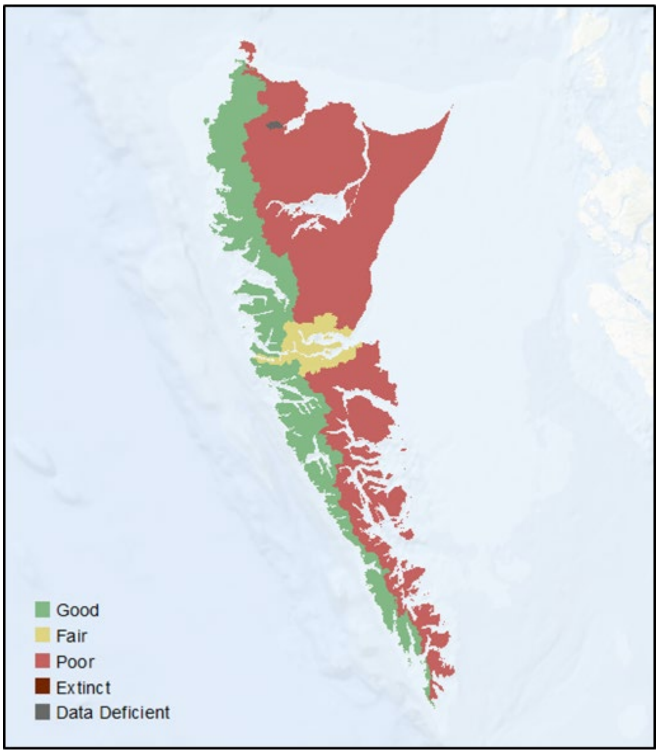

Figure 46. Pacific Salmon Foundation biological status of Haida Gwaii chum salmon Conservation Units.

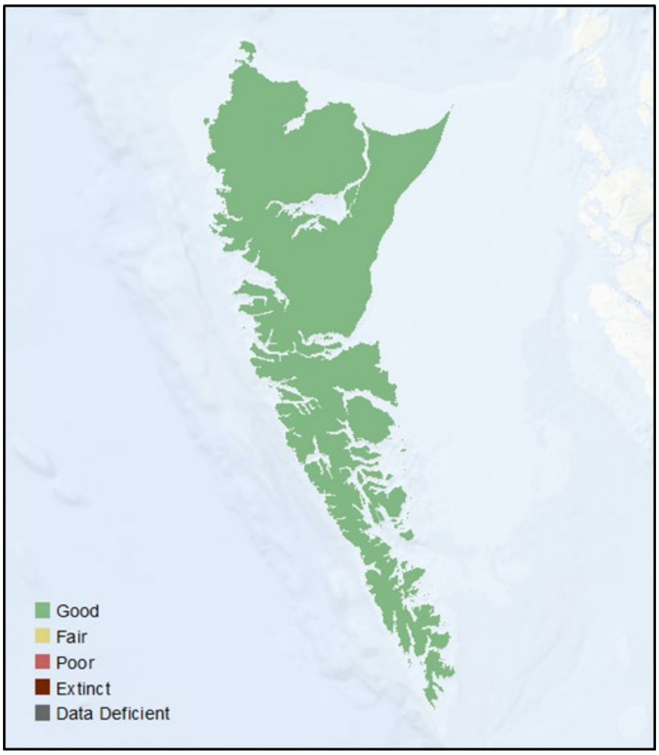

Figure 47. Pacific Salmon Foundation biological status of Haida Gwaii coho salmon Conservation Units.

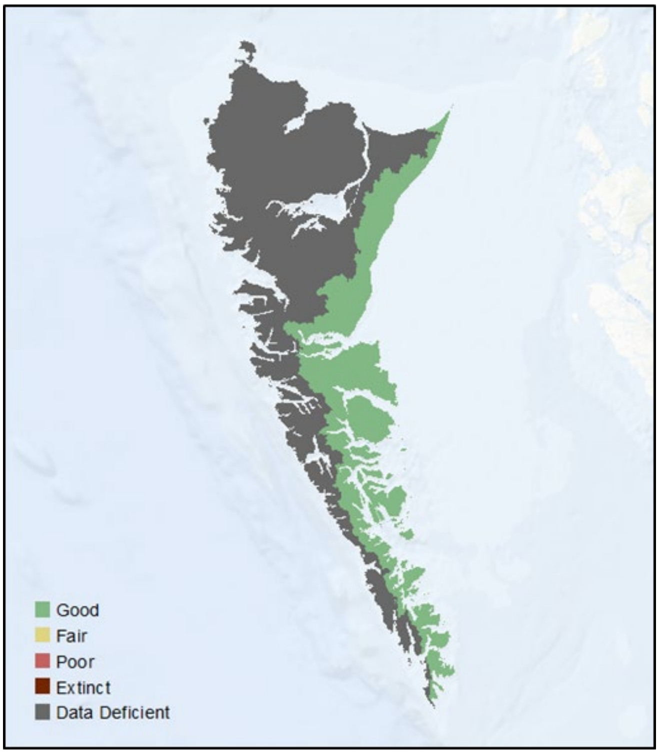

Figure 48. Pacific Salmon Foundation biological status of Haida Gwaii pink (odd) salmon Conservation Units.

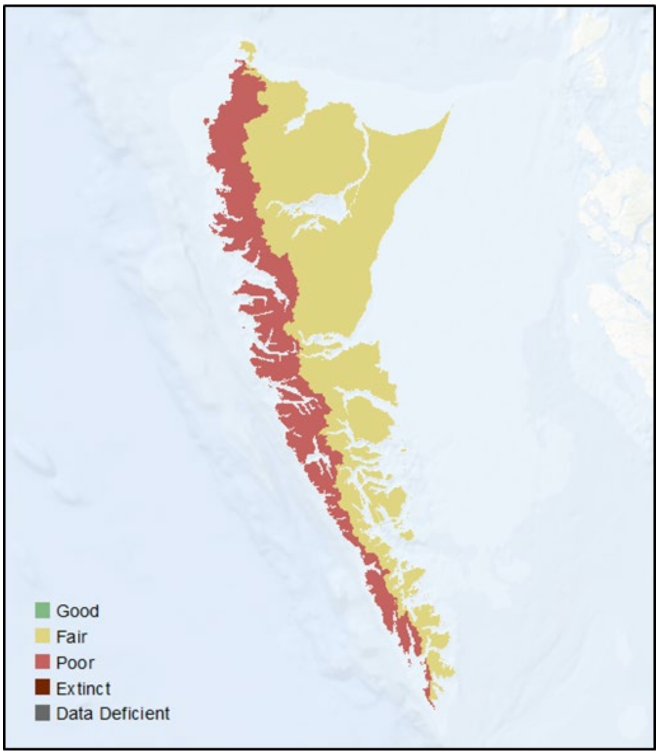

Figure 49. Pacific Salmon Foundation biological status of Haida Gwaii pink (even) salmon Conservation Units.

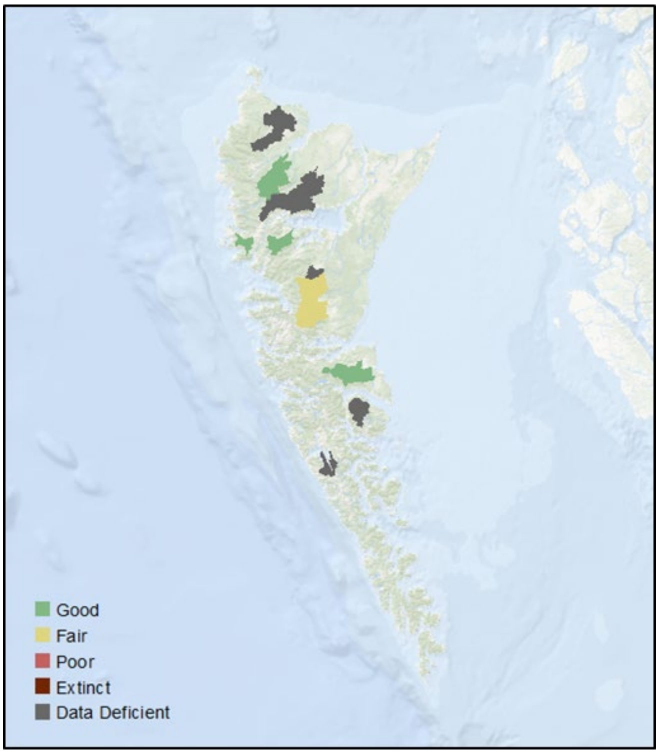

Figure 50. Pacific Salmon Foundation biological status of Haida Gwaii sockeye (lake-type) salmon Conservation Units.

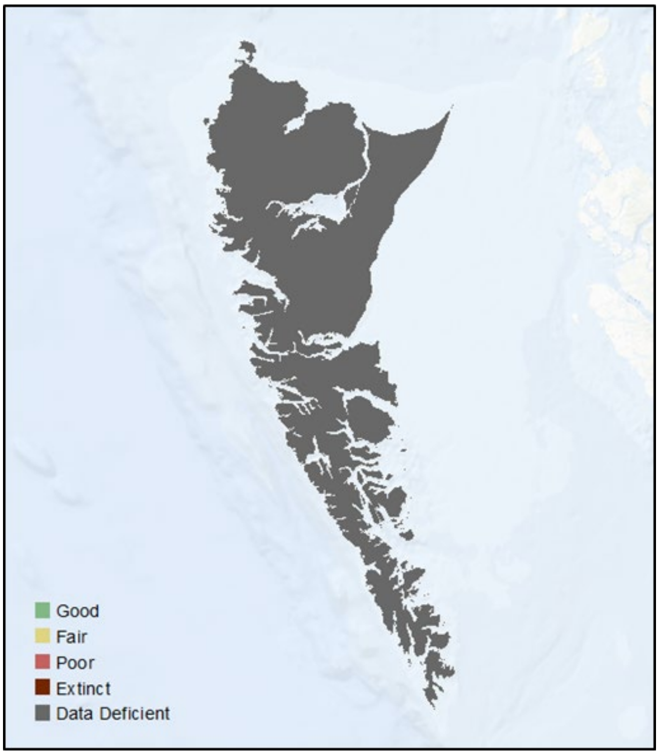

Figure 51. Pacific Salmon Foundation biological status of Haida Gwaii sockeye (river-type) salmon Conservation Units.

B: Habitat Status

We completed habitat assessments for watersheds within the 29 salmon CUs in the Haida Gwaii Region. The habitat assessments produce two levels of outputs: (1) a risk rating for each Freshwater Atlas (FWA) assessment watershed in the Region for each individual habitat pressure indicator; (2) a cumulative pressure score for each FWA assessment watershed in the Region, representing the risk to a watershed from all habitat pressures combined. Of the 218 1:20K FWA assessment watersheds assessed in the Haida Gwaii Region, 67% (n= 145) were designated as spawning habitat based on compiled spawning location data. These 145 watersheds represent the combined spawning ZOI for all species. In terms of the cumulative pressure scores for the spawning habitat defined by these 145 watersheds, 32% of the spawning habitat is high risk (red), 27% is moderate risk (amber), and 41% is low risk (green). The percentage of spawning habitat area in each risk category for each indicator is summarized in Table 18 below.

Quantifying both individual and cumulative pressures at the FWA assessment watershed-scale provides a snapshot of habitat pressures across Haida Gwaii and highlights which CUs face the greatest risk. Specifically, an overview of habitat pressures emerges from identifying:

1) the percent area of watersheds within the combined spawning ZOI for all species that are rated high, moderate, or low risk (i.e. red, amber, green) for each of the evaluated individual habitat pressure indicators; and

2) the percent area of watersheds within the combined spawning ZOI for all species that are rated high, moderate, or low risk (i.e. red, amber, green) for cumulative habitat pressures;

More information on habitat pressure benchmark values for each indicator is available in Appendix 12. More information on cumulative spawning Pressure Results by Region and Conservation Unit is available in Appendix 13. Full results are available online through the Pacific Salmon Explorer. For each CU, the results can be accessed from the Pacific Salmon Explorer, and the datasets compiled for the analysis are available for download via the Salmon Data Library.

Table 18. The percentage of spawning habitat area within the Haida Gwaii Region's combined spawning ZOI for all species that are rated high, moderate, or low risk (i.e. red, amber, green) for each of the evaluated individual habitat pressure indicators.

Indicator	% Area of Spawning Habitat		
	High Risk	Moderate Risk	Low Risk
Total Landcover Alteration	30%	29%	41%
Forest Disturbance	31%	27%	42%
Impervious Surfaces	0%	18%	82%
Mines	13%	n/a	87%
Linear Development	29%	28%	43%
Road Development	33%	20%	47%
Stream Crossing Density	2%	63%	35%
Riparian Disturbance	40%	14%	46%
Water Licenses	12%	n/a	88%
Waste Water Discharges	2%	n/a	98%
Equivalent Clearcut Area	19%	11%	70%
Insect and Disease Defoliation	0%	n/a	100%
Cumulative Pressures	32%	27%	41%

5.7 Columbia Region

The headwaters of the Columbia River in Canada are part of a vast system over 2000 km in length, with much of the watershed located within the continental United States (US). We have not assessed the biological status or threats to salmon habitats within those areas outside of Canada (Figure 52), having defined the Columbia region as the entirety of the watershed in Canada. There are two salmon CUs within the Canadian 'Columbia Region' on the Pacific Salmon Explorer - one Chinook and one lake-type sockeye. The process of data gathering and synthesis to complete the initial assessments within the Columbia Region took place over a number of years and was completed in 2022.

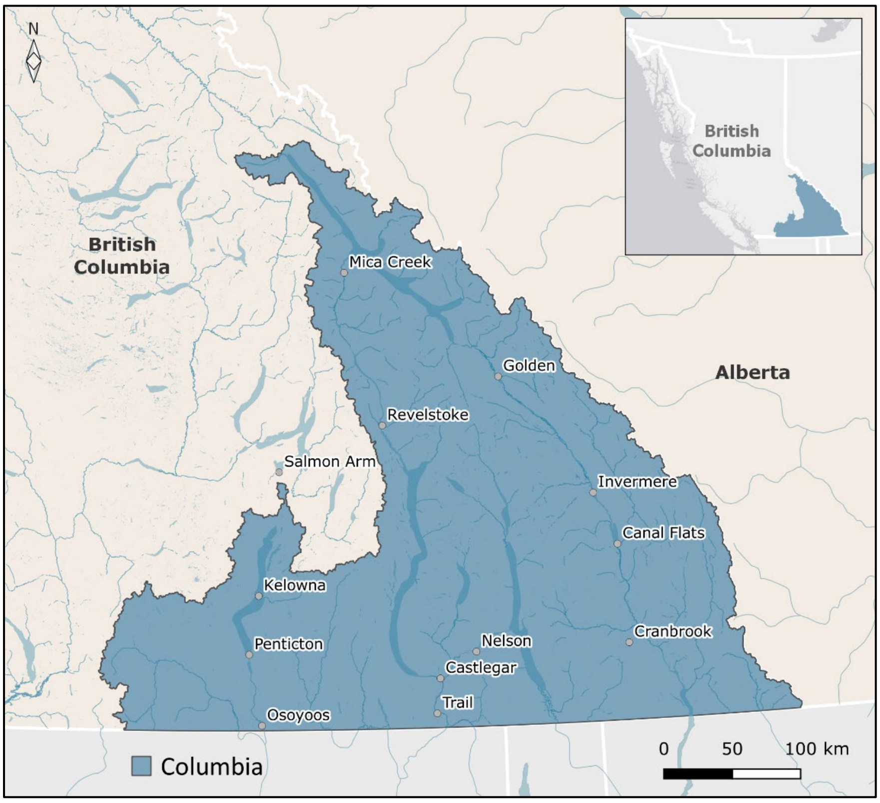

Figure 52. Map of the Columbia Region.

The Columbia River has an extensive history of development, including dams – salmon have been extirpated from most of the upper Columbia drainage in Canada for more than 80 years. The Okanagan River sub-basin contains the only remaining salmon populations. While two CUs are currently defined, local and traditional knowledge and downstream observations suggest a spring Chinook run (distinct from the current Chinook CU) and coho also occur in the region. Steelhead passage also occurs through the Zosel dam, just south end of Osoyoos lake, a cross border lake.

5.7.1 Biological Data and Analytical Methods

In the Columbia Region, we accessed datasets for biological indicators from published reports (COSEWIC, 2017; Hyatt & Stockwell, 2019; Matylewich et al., 2019) and DFO (Ogden, pers comm). Additional data was sourced from NuSEDS if applicable. Details on specific data sources and analytical methods for the Columbia Region are described below.

A: Spawner Surveys

Spawner survey data for streams in the Columbia Region were sourced from DFO's (New Salmon Escapement Database (NuSEDS) and Ogden, pers comm), COSEWIC (2017), Matylewich et al. (2019), and Hyatt and Stockwell (2019). For a description of the spawner survey indicator, see Section 4.1.1. Overview of Biological Indicators, A: Spawner Surveys.

B: Spawner Abundance

Observed spawner abundance for CUs in the Columbia Region, represent the total number of mature salmon that return to a CU to spawn in a given year. Stockwell and Hyatt (2003) describe survey methods and analytical techniques of summary estimates of annual escapement. Considerations in spawner abundance are also described in Section 4.1.1. Overview of Biological Indicators, B: Spawner Abundance.

Columbia CU-level **estimates of spawner abundance** (run reconstructions) were sourced from COSEWIC (2017), Matylewich et al. (2019), Hyatt & Stockwell (2019) and DFO (Ogden, pers comm).

C: Run Timing

Estimates of the average timing at which Okanagan watershed salmon return to spawn were based on run timing at Zosel Dam (Columbia River DART, 2022). The duration of the timing of river entry has an assumed bell-shaped curve (i.e. normal distribution). The shape of the curve is defined by the mean and standard deviation of the available run timing data. For Osoyoos sockeye and Okanagan Chinook, the run timing values are comprised of averaged values from 2006-2017. Note that salmon migrating up the Columbia and Okanagan are known to be heavily affected by water temperatures in any given year (Hyatt et al., 2003). See Section 4.1.1. Overview of Biological Indicators, C: Run Timing for a description of the run timing indicator and methods.

D: Catch & Run Size

Catch and run size and subsequent exploitation rates for CUs on the Columbia were sourced from Hyatt and Stockwell (2019) for sockeye and were not available for Chinook. For a description of catch and run size methods, see Section 4.1.1. Overview of Biological Indicators, D: Catch & Run Size.

E: Recruits-per-Spawner

Recruits-per-spawner data for CUs in the Columbia Region were not available. For a description of recruits-per-spawner methods, see Section 4.1.1. Overview of Biological Indicators, E: Recruits-per-Spawner.

F: Trends in Spawner Abundance

Trends in spawner abundance for CUs in the Columbia Region were derived from Spawner Abundance Estimates. For a description of trends in spawner abundance methods, see Section 4.1.1. Overview of Biological Indicators, F: Trends in Spawner Abundance.

G: Juvenile Surveys

Juvenile survey data for CUs in the Columbia were not available. For a description of the juvenile surveys indicator, see Section 4.1.1. Overview of Biological Indicators, G: Juvenile Surveys.

H: Hatchery Releases

Hatchery releases in the Columbia Region for all species were provided by DFO (Joan Bateman, Salmonid Enhancement Program). Refer to Section 4.1.1. Overview of Biological Indicators, H: Hatchery Releases for details on data and analytical methods.

I: Biological Status

The **biological status** assessments for CUs in the Columbia Region currently reflect sockeye data sourced from the Hyatt and Stockwell (2019) and DFO current to 2020. There was insufficient data for Chinook status assessment at this time, but an expert COSEWIC review (2017) determined an "Endangered" status with data to 2015. As new data become available, we will update the analyses and results in this report as well as on the Pacific Salmon Explorer. See Sections 4.1.4. Benchmarks for Assessing Biological Status and 4.1.5. Decision Rules for Assessing Biological Status for more details on biological status assessment methods.

5.7.2 Habitat Data and Analytical Methods

Nuances regarding habitat pressure indicator data and analytical methods for the Columbia Region are listed below. Refer to Section 4.2 Indicators and Benchmarks for Assessing Habitat Status for information on habitat pressure indicators, benchmarks, and the analytical methods used to assess habitat status. Additional details on habitat pressure indicators, data sources, data currency, and benchmarks specific to the Columbia Region are available in Appendix 6 (Description of Habitat Pressure Indicators & Relevance to Salmon), Appendix 7 (Habitat Pressure Datasets & Data Sources), Appendix 8 (Spatial

Data Processing for Habitat Pressure Indicators), Appendix 9 (Spatial Data Processing for Future Pressures), and Appendix 12 (Habitat Pressure Benchmark Values by Region).

A: Spawning Zones of Influence

Methods for delineating Chinook CU **spawning zones of influence (ZOIs)** vary by region in accordance with the CU delineation approach used by DFO. In the Fraser, Vancouver Island and Mainland Inlets, and Columbia regions, Chinook CUs are more broadly defined geographically, which means that the methods employed for determining pink, chum, and coho spawning ZOIs were also applicable to Chinook CUs. The localized spawning ZOI for each Columbia Chinook CU was delineated by capturing the extent of all 1:20K FWA assessment watersheds that directly intersect with known spawning locations for Chinook.

B: Spatial Data Processing for Habitat Pressure Indicators

i: Total Land Cover Alteration on Columbia

The spatial data processing method for total land cover alteration in the Columbia region used newly available data sources from the Province of BC's Cumulative Effects Framework (BC CEF) team. BC CEF's Human Disturbance with Base Thematic Mapping (2021) dataset was used as the data source for polygons representing the following disturbance types: mountain pine beetle, railway and airports, recreation, transmission lines, major rights of ways, mining, oil & gas infrastructure, seismic infrastructure, agriculture, and urban areas. BC CEF's Integrated Roads (2021) dataset was used as the data source for roads which were then buffered as outlined for processing the road development indicator (Appendix 8).

iii: Riparian Disturbance on Columbia

The riparian disturbance indicator used the total land cover alteration layer as an input data layer. As such, the spatial data processing methods used newly available data sources from the Province of BC's Cumulative Effects Framework (BC CEF) team (Appendix 8).

iv: Road Development in the Columbia Region

The spatial data processing method for road development in the Columbia region used the newly available Integrated Roads (2021) dataset from the Province of BC's Cumulative Effects Framework team (Appendix 8).

v: Linear Development in the Columbia Region

The spatial data processing method for linear development in the Columbia region used the newly available Integrated Roads (2021) dataset from the Province of BC's Cumulative Effects Framework team (Appendix 8).

vi: Equivalent Clearcut Area in the Columbia Region

The spatial data processing method for calculating equivalent clearcut area (ECA) used the total land cover alteration layer as an input data layer. As such, the spatial data processing methods used newly available data sources from the Province of BC's Cumulative Effects Framework (BC CEF) team (Appendix 8). Specifically, BC CEF's Human Disturbance with Base Thematic Mapping (2021) dataset was used as the data source for polygons representing the following disturbance types: mountain pine beetle, railway and airports, transmission lines, major rights of ways, mining, oil & gas infrastructure, seismic infrastructure, agriculture, and urban areas. BC CEF's Integrated Roads dataset was used as the data source for roads which were then buffered as outlined for processing the road development indicator (Table A.18; Appendix 8). Fire polygons were sourced from the Current Fire Perimeters and Historical Fire Perimeters datasets available on DataBC. Harvested areas were sourced from the Vegetation Resources Inventory (VRI) database available on DataBC.

ECA disturbance types were identified as "recoverable" and "non-recoverable." Non-recoverable disturbance types are those where the land disturbance is considered permanent and recorded as 100% ECA. Non-recoverable disturbance types include railway and airports, transmission lines, major rights of way, mining, oil & gas infrastructure, seismic infrastructure, agriculture, and urban areas. Recoverable disturbance types, where the hydrologic function of the landscape is expected to recover over time (i.e. second-growth forest), include harvested areas, burned areas, and areas impacted by mountain pine. ECA recovery curves identify a recovery factor based on stand height. Projected stand height is sourced from the VRI dataset. ECA recovery curves were updated in 2019 to differentiate recovery rates for interior and coastal forests (FREP 2019).

A "non-recoverable" layer was created by first merging and dissolving all non-recoverable disturbance types. Harvested and burned area polygons were dissolved based on projected stand height and then merged with the non-recoverable layer. Lastly, harvested area and burned area polygons without stand height but with a date of disturbance were dissolved based on time since disturbance (years) and merged with the non-recoverable and recoverable polygons with stand height. This combined ECA layer was overlaid with the FWA assessment watersheds. The growth recovery of each polygon was calculated based on stand height using the interior recovery curve or using a time since disturbance surrogate method where stand height information was not readily available. The growth recovery of each recoverable polygon with stand height information was calculated using the following equation:

$$ECA = A*C(1-R/100)$$

where A is the original polygon area, C is the proportion of the opening covered by functional regeneration (determined from Table A2.1, MOF 2001), and R is the recovery factor (for coastal forests from Hudson and Horel (2007) and from Winkler and Boon (2015) for interior forests). For non-recoverable polygons, there is no functional regeneration or recovery factor, so for these polygons, C will be equal to 1, and R will be equal to 0. Where stand height is not available (e.g. for harvested areas sourced from the Gowgaia Institute), a time since disturbance surrogate was used to estimate ECA: 1-10 yrs. = 100% ECA, 11-20 = 75%, 21-40 = 25% and 40-50 yrs. = 5%, >50 years = 0%[2]. ECA was summed for each FWA watershed and then divided by the total watershed area to give an ECA percentage for each watershed.

C: Spawning Habitat Information

Spawning areas identified in the Known BC Fish Observations and Distributions were minimal. We supplemented this data with local knowledge and information in published literature, including sockeye (Stockwell and Hyatt (2003), Hyatt and Stockwell (2019), Stockwell et al. (2020), and Chinook (Matylewich et al. (2019), Mahony et al. (2021)).

5.7.3 Results

A: Biological Status

This section provides a high-level overview of the biological status results for the two salmon CUs in the Columbia Region. Of the two CUs we examined in the Region, we were able to assess biological status for one CU (50%). The remaining salmon CUs had insufficient information for evaluating their biological status (see Section 4.1.5 Decision Rules for Assessing Biological Status for the criteria used to define data deficient CUs). For the Osoyoos sockeye CU, we were able to assess status using the spawner abundance percentile benchmark method, which was in the green status zone. Biological status for each CU is displayed by species in Figures 53-54 below. More information on biological status and benchmarks for each CU is available in Table A.12 in Appendix 4. Full results are available online through the Pacific Salmon Explorer, where individual figures, maps, data, and summary statistics are provided for each CU in the Region. The results of these assessments reflect data that are current to 2020

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[2] BC Cumulative Effects Framework (BC CEF) ECA method includes an additional step to approximate stand height where not available in VRI before defaulting to this time since disturbance surrogate ECA estimate. This data was not available to us at the time of our assessments but our upcoming work to revise our habitat indicator methods will aim to source ECA directly from BC CEF or to update our methods to fill stand height data gaps where possible.

for sockeye and 2015 for Chinook. As new data becomes available, we will update the analyses and results in this report and the Pacific Salmon Explorer.

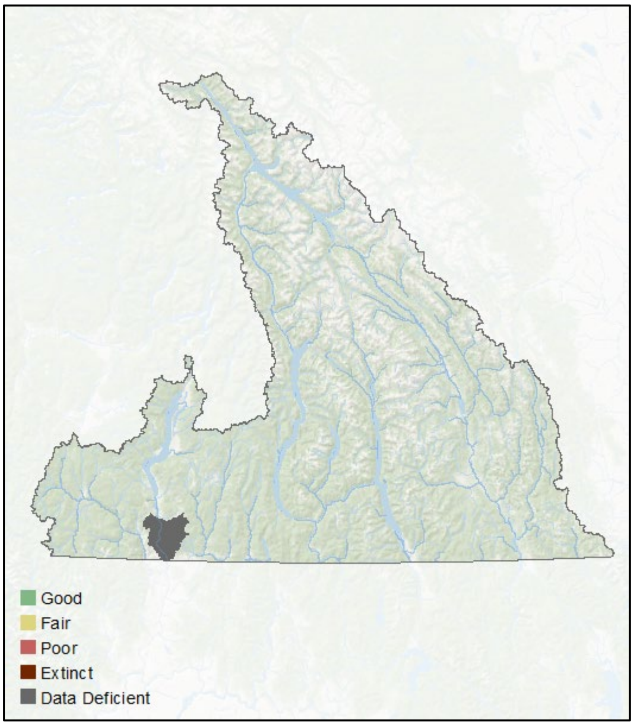

Figure 53. Pacific Salmon Foundation biological status of Columbia Chinook salmon Conservation Unit – Okanagan Chinook.

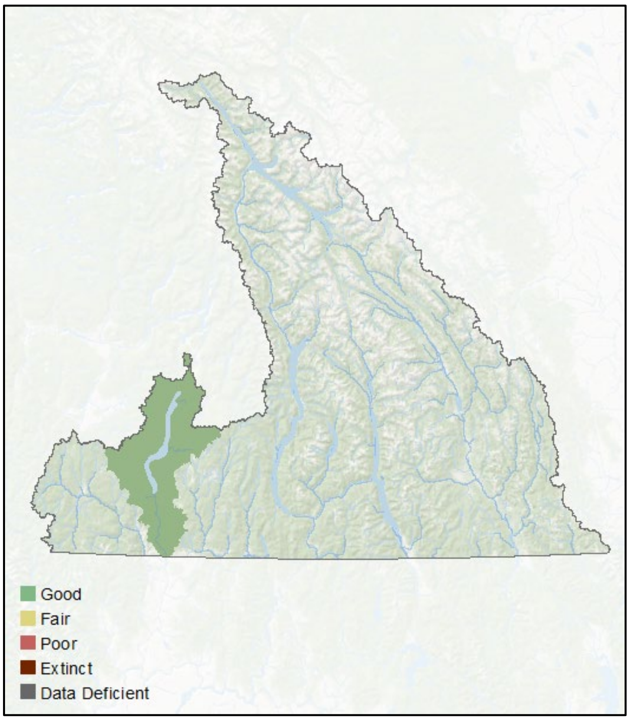

Figure 54. Pacific Salmon Foundation biological status of Columbia sockeye (lake-type) salmon Conservation Unit – Osoyoos Sockeye.

B: Habitat Status

We completed habitat assessments for watersheds within the two salmon CUs in the Columbia Inlets Region. The habitat assessments produce two levels of outputs for spawning ZOIs: (1) a risk rating for each FWA assessment watershed in the study area for each individual habitat pressure indicator; (2) a cumulative pressure score for each FWA assessment watershed in the study area, representing the risk to a watershed from all habitat pressures combined. Of the 2130 1:20K FWA assessment watersheds assessed in the Columbia Region, 7% (n= 150) were designated as spawning habitat based on compiled spawning location data. These 150 watersheds represent the combined spawning ZOI for all species. In terms of the cumulative pressure scores for the 150 spawning watersheds, 0% are low risk (red), 5% are moderate risk (amber), and 95% are high risk. The percent of spawning watersheds in each risk category for each indicator is summarized in Table 18 below.

Quantifying both individual and cumulative pressures at the FWA assessment watershed-scale provides a snapshot of habitat pressures across the entire Columbia region and highlights which CUs face the greatest risk. Specifically, an overview of habitat pressures emerges from identifying:

1) the percentage of watersheds within the combined spawning ZOI for all species that are rated high, moderate, or low risk (i.e. red, amber, green) for each of the evaluated individual habitat pressure indicators; and

2) the percentage of watersheds within the combined spawning ZOI for all species that are rated high, moderate, or low risk (i.e. red, amber, green) for cumulative habitat pressures;

More information on habitat pressure benchmark values for each indicator is available in Appendix 12. More information on cumulative spawning Pressure Results by Region and Conservation Unit is available in Appendix 13. Full results are available online through the Pacific Salmon Explorer. For each CU, the results can be downloaded directly from the Pacific Salmon Explorer. The datasets compiled for the analysis are also available for download via the Salmon Data Library.

Table 19. The percentage of 1:20K Freshwater Atlas assessment watersheds within the combined spawning ZOI (n = 148) for all species in the Columbia Region that are rated high, moderate, or low risk (i.e. red, amber, green) for each of the evaluated individual habitat pressure indicators.

Indicator	% Area of Spawning Habitat			
	High Risk	Moderate Risk	Low Risk	Data Deficient
Total Landcover Alteration	69% (102)	22% (32)	9% (14)	0% (0)
Forest Disturbance	57% (85)	18% (27)	14% (20)	11% (16)
Impervious Surfaces	11% (17)	80% (118)	9% (13)	0% (0)
Mines	36% (54)	n/a	64% (94)	0% (0)
Linear Development	72% (106)	23% (35)	5% (7)	0% (0)
Road Development	97% (144)	3% (4)	0% (0)	0% (0)
Stream Crossing Density	14% (21)	76% (112)	10% (15)	0% (0)
Riparian Disturbance	91% (134)	8% (12)	1% (2)	0% (0)
Water Licenses	89% (131)	n/a	11% (17)	0% (0)
Waste Water Discharges	20% (29)	n/a	80% (119)	0% (0)
Equivalent Clearcut Area	76% (113)	13% (19)	11% (16)	0% (0)
Insect and Disease Defoliation	24% (36)	74% (109)	2% (3)	0% (0)
Cumulative Pressures	95% (140)	5% (8)	0% (0)	0% (0)

**The number of watersheds in each risk category are presented in parenthesis.*

6. Conclusions and Future Directions

By synthesizing and providing open access to information and standardized assessments of salmon biological status and pressures on freshwater habitats, the Pacific Salmon Explorer can help inform and improve decision-making for the conservation and management of wild salmon. This information can help identify where to apply management interventions to support the recovery of at-risk populations and where more research and monitoring efforts are needed to assess threats to salmon habitat properly.

Determining which CUs are high priorities for management interventions and recovery planning is challenging. It requires both assumptions and acceptance of the inherent uncertainty in assessing biological status and habitat pressures. Acknowledging these challenges, we suggest prioritizing efforts under two scenarios. (1) CUs whose biological status is in the red status zone based on both PSF assessments and other integrated status assessments, and (2) CUs where biological status is data deficient and habitat risk level is red. However, given the numerous trade-offs and other factors to consider in conservation planning, we recommend that the Pacific Salmon Explorer outputs be considered part of a broader strategic planning approach. One that considers societal values, recovery potential, and the feasibility and cost of management and conservation actions.

Compiling and synthesizing information all available data sources related to salmon and Salmon CUs serves to improve our understanding of wild salmon population status and the apparent reasons for a given status. Additional pressures affecting salmon that are not currently included on the Pacific Salmon Explorer should also be considered. For example, climate change-related indicators and indicators of marine productivity have important implications for the productivity and abundance of wild Pacific salmon. Given the iterative nature of our work, the current set of biological and habitat indicators are likely to evolve, and this technical report and its methodologies will be updated accordingly.

PSF intends to continue working in collaboration with Fisheries and Oceans Canada, First Nations, and other salmon experts to regularly update the biological and habitat indicators used for assessments to ensure that the Pacific Salmon Explorer remains a comprehensive and trusted resource for informing decision making associated with salmon conservation, management, and recovery.

Glossary

Benchmark: A standard point of reference against which a condition can be compared.

Brood year: The year that a cohort of salmon spawns.

Carrying capacity: The maximum population size that can be sustained indefinitely in the absence of harvesting. Carrying capacity can refer to specific habitats (e.g. a sockeye nursery lake) or over the lifetime of a species (e.g. across life stages).

Catch: The number of adult salmon that are caught in commercial, recreational, and First Nations fisheries.

Conservation Unit (CU): A geographically, ecologically, and genetically distinct population group of wild Pacific salmon. A CU can contain one or more populations of salmon. Conservation Units were created under Canada's Wild Salmon Policy to enable DFO to identify and manage the diversity of wild salmon. www.salmonwatersheds.ca/wsp/

CU-level: Conservation Unit level is the resolution or geographic scale of the data used for biological status assessments.

DFO or **Fisheries and Oceans Canada:** The federal government branch responsible for fisheries and oceans management in Canada. Formerly the Department of Fisheries and Oceans is still widely referred to as DFO.

Escapement: The number of mature salmon that pass through (escape) fisheries capture and return to freshwater to spawn.

Exploitation rate: The proportion of the total run or yearly population that is caught in all fisheries.

Freshwater Atlas (FWA): A standardized dataset for mapping British Columbia's hydrological features, created by the Province of British Columbia. Freshwater Atlas Data

FWA watershed: Watersheds as represented in the Province of British Columbia's Freshwater Atlas (FWA) Assessment Watersheds dataset, which are defined at a 1:20,000 watershed scale. FWA assessment watersheds are delineated with sizes between 2,000 to 10,000 hectares by the province.

Habitat indicator: Characteristics of the environment that, when measured, describe habitat condition, the magnitude of stress, degree of exposure to a stressor, or ecological response to exposure.

Indicator stream / non-indicator stream: All spawning streams that are listed to be monitored by DFO are classified as an indicator or non-indicator stream. Indicator streams are those that have been identified in some Regions as providing more reliable indices of spawner abundance. Indicator streams tend to give relatively accurate annual spawner abundance estimates, given that they use higher quality methodologies and are more intensively/regularly surveyed. Indicator streams are also assumed to be representative of spawner returns to other streams in close geographic proximity. Non-indicator streams are typically less consistently surveyed, using more variable methodologies, and/or may simply be difficult to survey (e.g. poor water quality, remote location, etc.).

Life history stage: A classification scheme that divides salmon life stages into categories such as migration, spawning, egg incubation, fry, and juvenile rearing, which are based on body morphology, behavior, and reproductive potential,

Pacific Salmon Explorer: An online data visualization tool created by the Pacific Salmon Foundation displays information on Pacific salmon and their habitats in British Columbia. salmonexplorer.ca

Population: A group of interbreeding salmon that are sufficiently geographically isolated from others such that persistent adaptations to their local environmental conditions develop over time. These adaptations have been linked to distinct life-history strategies in order to maximize fitness over time.

Pressure indicator: Measurable extent or intensity of natural processes or human activities that can directly or indirectly lead to changes in habitat conditions or state that can be measured qualitatively or quantitatively.

Recruitment: The individual juveniles that survive and are added to a population. Recruitment in the context of salmon management usually refers to the abundance of adults before fishing. Recruitment is typically calculated as the sum of escapement, all fisheries catches, and estimated pre-spawn and post-release mortality.

Region: A geographic boundary by which Conservation Units are grouped into assessment areas.

Riparian zone: The area of vegetation near streams and other water bodies that is influenced by the proximity to water. For management, DFO guidelines typically recognize the riparian zone as the terrestrial area within 30 meters of any water body.

Risk: The risk of adverse effects to salmon habitats within a defined *zone of influence*. Increasing risk levels are defined based on the extent or intensity of impacts relative to defined *benchmarks* for each *habitat indicator*.

Run size: The total number of adult salmon that return each year from the ocean, including those that reach the spawning grounds (i.e. estimated spawner abundance) and those that are caught or intercepted on route to the spawning grounds in fisheries.

Salmon Habitat Mapper: An online spatial data visualization tool for exploring and contributing salmon spawning data, created by the Pacific Salmon Foundation to simplify the process of engaging with local experts to document salmon spawning habitat. The Salmon Habitat Mapper allows users to navigate interactive maps and add additional spawning data or comment on existing locations via a password-accessible portal. This data then improves the habitat assessments visualized in the *Pacific Salmon Explorer*.

Smolt: A juvenile salmon that is mature enough to migrate from freshwater to the marine environment.

Sockeye (lake- vs. river-type): Sockeye belong to one of two distinct life history types, which are described as separate sockeye Conservation Units. After hatching, fry from lake-type sockeye Conservation Units migrate to a rearing lake where they spend a year feeding and maturing into smolts, whereas fry from river-type sockeye Conservation Units rear in flowing water and migrate to the ocean as smolts soon after emergence.

State indicator: Physical, chemical, or biological attributes measured to characterize environmental conditions.

Status: Condition relative to a defined indicator benchmark.

Watershed: The area of land that drains water, sediment, and dissolved materials into a stream, river, lake, or ocean. Watersheds can be defined at various spatial scales, with delineated boundaries ranging from a single tributary stream to an entire mainstem river.

Wild salmon: Salmon are considered "wild" if they have spent their entire life cycle in the wild, originate from parents produced by natural spawning that has also continuously lived in the wild.

Zone of influence (ZOI): Areas upstream or adjacent to the habitats used by salmon during various life stages (e.g. spawning or rearing). ZOIs represent the geographic extent for the assessment of habitat *pressure indicators*.

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Appendices

Appendix 1: Conservation Unit Reference List

Skeena Region

Table A. 1. Conversation Units in the Skeena Region (n=55), listed by species. Overview of the number of CUs by species: 12 Chinook, 4 chum, 4 coho, 3 pink (even-year), 2 pink (odd-year), 28 sockeye (lake-type), and 2 sockeye (river-type). The CUs Names and Index are based on Holtby and Ciruna (2007).

Species	Conservation Unit	CU ID	CU Index
Chinook	Ecstall	205	46
	Kalum-Early	206	49
	Kalum-Late	207	50
	Lakelse	227	51
	Lower Skeena	210	48
	Middle Skeena-Large Lakes	222	53
	Middle Skeena-Mainstem Tributaries	217	54
	Sicintine	241	81
	Skeena Estuary	224	45
	Upper Bulkley River	221	55
	Upper Skeena	212	56
	Zymoetz	229	80
Chum	Lower Skeena	202	32
	Middle Skeena	215	33
	Skeena Estuary	225	31
	Upper Skeena	180	NA
Coho	Lower Skeena	202	32
	Middle Skeena	215	33
	Skeena Estuary	225	31
	Upper Skeena	231	34
Pink (even-year)	Middle-Upper Skeena	218	08

Species	Conservation Unit	CU ID	CU Index
	Nass-Skeena Estuary	219	07
Pink (odd-year)	Lower-Skeena River	209	15
	Middle-Upper Skeena	213	16
	Nass-Skeena Estuary	223	14
Sockeye (lake-type)	Alastair	171	L-20-01
	Asitika	190	L-22-01
	Azuklotz	191	L-22-02
	Babine (enhanced)	203	L-21-02-EW
	Babine/Onerka	180	L-21-02-F
	Bear	192	L-22-03
	Bulkley/Maxan	181	L-21-03
	Damshilgwit	193	L-22-04
	Ecstall/Lower	174	L-20-04
	Footsore/Hodder	230	L-21-12
	Gitanyow (Kitwanga/Kitwancool)	183	L-21-05
	Johanson	194	L-22-05
	Johnston	175	L-20-05
	Kitsumkalum	176	L-20-06
	Kluatantan	195	L-22-06
	Kluayaz	196	L-22-07
	Lakelse	177	L-20-07
	Mcdonell/Dennis/Aldrich	178	L-20-08
	Morice/Atna	185	L-21-07
	Motase	197	L-22-08
	Nilkitkwa	186	L-21-02-LW
	Sicintine	198	L-22-09
	Slamgeesh	199	L-22-10

Species	Conservation Unit	CU ID	CU Index
	Spawning	200	L-22-11
	Stephens	187	L-21-09
	Sustut	201	L-22-12
	Swan/Club	188	L-21-10
	Tahlo/Morrison	189	L-21-02-MW
Sockeye (river-type)	Skeena River	226	R18
	Skeena River-High Interior	216	R19

Nass Region

Table A. 2. Conversation Units in the Nass Region (n=21), listed by species. Overview of the number of CUs by species: 2 Chinook, 3 chum, 3 coho, 1 pink (even-year), 2 pink (odd-year), 8 sockeye (lake-type), and 2 sockeye (river-type). The CUs Names and Index are based on Holtby and Ciruna (2007).

Species	Conservation Unit	CU ID	CU Index
Chinook	Portland Sound-Observatory Inlet-Lower Nass	401	57
	Upper Nass	402	58
Chum	Lower Nass	405	31
	Portland Canal-Observatory	406	32
	Portland Inlet	404	30
Coho	Lower Nass	408	35
	Portland Sound-Observatory Inlet-Portland Canal	410	37
	Upper Nass	409	36
Pink (even-year)	Upper Nass	412	NA
Pink (odd-year)	Nass-Portland-Observatory	414	17
	Upper Nass	415	NA

Sockeye (lake-type)	Bowser	420	NA
	Clements	418	NA
	Damdochax	421	L-24-02
	Fred Wright	422	L-24-03
	Kwinageese	423	NA
	Leverson	419	NA
	Meziadin	424	L-24-05
	Oweegee	425	NA
Sockeye (river-type)	Lower Nass-Portland	426	R20
	Upper Nass River	427	R21

Central Coast Region

Table A. 3. Conversation Units in the Central Coast Region (n=114), listed by species.
Overview of the number of CUs by species: 7 Chinook, 9 chum, 8 coho, 2 pink (even-year), 3 pink (odd-year), 3 sockeye (river-type), and 82 sockeye (lake-type). The CU names and indexes are based on Holtby and Ciruna (2007).

Species	Conservation Unit	CU ID	CU Index
Chinook	Bella Coola-Bentinck	512	39
	Dean River	513	40
	Docee	509	36
	North & Central Coast-Early	515	42
	North & Central Coast-Late	514	41
	Rivers Inlet	510	37
	Wannock	511	38
Chum	Bella Coola River-Late	505	17
	Bella Coola-Dean Rivers	504	16
	Douglas-Gardner	508	20

Species	Conservation Unit	CU ID	CU Index
	Hecate Lowlands	506	18
	Mussel-Kynoch	507	19
	Rivers Inlet	501	13
	Smith Inlet	500	12
	Spiller-Fitz-Hugh-Burke	503	15
	Wannock	502	14
Coho	Bella Coola-Dean Rivers	518	22
	Brim-Wahoo	521	28
	Douglas Channel-Kitimat Arm	522	29
	Hecate Strait Mainland	520	27
	Mussel-Kynoch	519	26
	Northern Coastal Streams	523	30
	Rivers Inlet	517	21
	Smith Inlet	516	20
Pink (even-year)	Hecate Lowlands	608	5
	Hecate Strait-Fjords	609	6
Pink (odd-year)	Hecate Strait-Fjords	612	13
	Hecate Strait-Lowlands	611	12
	Homathko-Klinaklini-Smith-Rivers-Bella Coola-Dean	610	8
Sockeye (lake-type)	Backland	529	L-18-01
	Banks	540	L_19_01
	Bloomfield	541	L_19_02
	Bolton Creek	542	L_19_03
	Bonilla	543	L_19_04
	Borrowman Creek	544	L_19_05
	Busey Creek	545	L_19_06

Species	Conservation Unit	CU ID	CU Index
	Canoona	532	L_18_02
	Cartwright Creek	546	L_19_07
	Chic	547	L_19_08
	Citeyats	548	L_19_09
	Curtis Inlet	550	L_19_11
	Dallain Creek	551	L_19_12
	Deer	552	L_19_13
	Devon	553	L_19_14
	Dome	533	L_18_03
	Douglas Creek	554	L_19_15
	Elizabeth	555	L_19_16
	Elsie/Hoy	556	L_19_17
	End Hill Creek	557	L_19_18
	Evelyn	534	L_18_04
	Evinrude Inlet	558	L_19_19
	Fannie Cove	549	L_19_10
	Freeda	559	L_19_20
	Hartley Bay	560	L_19_21
	Hevenor Inlet	561	L_19_22
	Higgins Lagoon	562	L_19_23
	Kadjusdis River	563	L_19_24
	Kainet Creek	535	L_18_05
	Kdelmashan Creek	564	L_19_25
	Keecha	565	L_19_26
	Kent Inlet Lagoon Creek	566	L_19_27
	Kenzuwash Creeks	567	L_19_28
	Keswar Creek	568	L_19_29

Species	Conservation Unit	CU ID	CU Index
	Kildidt Creek	569	L_19_30
	Kildidt Lagoon Creek	570	L_19_31
	Kimsquit	536	L_18_06
	Kisameet	571	L_19_32
	Kitkiata	537	L_18_07
	Kitlope	538	L_18_08
	Koeye	572	L_19_33
	Kooryet	573	L_19_34
	Kunsoot River	574	L_19_35
	Kwakwa Creek	575	L_19_36
	Lewis Creek	576	L_19_37
	Limestone Creek	577	L_19_38
	Long	524	L_15_01
	Lowe/Simpson/Weir	578	L_19_39
	Mary Cove Creek	579	L_19_40
	Mcdonald Creek	580	L_19_41
	Mcloughlin	581	L_19_42
	Mikado	582	L_19_43
	Monckton Inlet Creek	583	L_19_44
	Namu	584	L_19_45
	Owikeno	525	L_15_02
	Pine River	539	L_18_09
	Port John	585	L_19_46
	Powles Creek	586	L_19_47
	Price Creek	587	L_19_48
	Roderick	588	L_19_50
	Ryan Creek	589	L_19_51

Species	Conservation Unit	CU ID	CU Index
	Salter	590	L_19_52
	Scoular/Kilpatrick	591	L_19_53
	Sheneeza Inlet	592	L_19_55
	Ship Point Creek	593	L_19_56
	Soda Creek	530	L_18_10
	South Atnarko Lakes	528	L_16_01
	Spencer Creek	594	L_19_57
	Stannard Creek	595	L_19_58
	Talamoosa Creek	596	L_19_59
	Tankeeah River	597	L_19_60
	Treneman Creek	598	L_19_61
	Tsimtack/Moore/Roger	599	L_19_62
	Tuno Creek East	600	L_19_63
	Tuno Creek West	601	L_19_64
	Tyler Creek	602	L_19_65
	Wale Creek	603	L_19_66
	Wannock (Owikeno)	527	L_15_04
	Watt Bay	604	L_19_67
	West Creek	605	L_19_68
	Yaaklele Lagoon	606	L_19_69
	Yeo	607	L_19_70
Sockeye (river-type)	Northern Coastal Fjords	614	R16
	Northern Coastal Streams	615	R17
	Rivers-Smith Inlets	613	R12

Fraser Region

Table A. 4. Conversation Units in the Fraser Region (n=62), listed by species. Overview of the number of CUs by species: 19 Chinook, 1 chum, 8 coho, 1 pink (odd-year), 23 sockeye (lake-type), and 2 sockeye (river-type) for a total of 54 CUs, as well as an additional 8 extinct sockeye (lake-type) CUs. The CU names and indexes are based on Holtby and Ciruna (2007).

Species	Conservation Unit	CU ID	CU Index
Chinook	Boundary Bay (Fall 41)	302	2
	Lower Fraser River (Fall 41)	303	3
	Lower Fraser River (Spring 52)	304	4
	Lower Fraser River (Summer 52)	306	6
	Lower Fraser River-Upper Pitt (Summer 52)	305	5
	Lower Thompson (Spring 42)	317	17
	Lower Fraser River-Maria Slough (Summer 41)	307	7
	Middle Fraser River (Spring 52)	310	10
	Middle Fraser River (Summer 52)	311	11
	Middle Fraser River-Portage (Fall 52)	309	9
	Fraser Canyon-Nahatlatch (Spring 52)	308	8
	North Thompson River (Spring 52)	318	18
	North Thompson River (Summer 52)	319	19
	Shuswap River (Summer 41)	315	15
	South Thompson (Summer 41)	313	13
	South Thompson (Summer 52)	314	14
	South Thompson River-Bessette Creek (Summer 42)	316	16
	South Thompson-Adams River Upper	333	82
	Upper Fraser River (Spring 52)	312	12
Chum	Lower Fraser	701	2
Coho	Boundary Bay	906	1

Species	Conservation Unit	CU ID	CU Index
	Fraser Canyon	705	5
	Interior Fraser	749	48
	Lillooet	704	4
	Lower Fraser	750	47
	Lower Thompson	707	7
	North Thompson	709	9
	South Thompson	708	8
Pink (odd-year)	Fraser River	710	1
Sockeye (lake-type)	Adams & Momich Lakes-Early Summer (de novo)	751	L-09-xx
	Adams-Early Summer (EXTINCT)	760	NA
	Alouette-Early Summer (EXTINCT)	756	NA
	Anderson-Seton-Early Summer	719	L-06-01
	Bowron-Early Summer	735	L-07-01
	Chilko-Early Summer	720	L-06-02
	Chilko-Summer	721	L-06-03
	Chilliwack-Early Summer (cyclic)	711	L-03-01
	Coquitlam-Early Summer (EXTINCT)	757	NA
	Cultus-Late	712	L-03-02
	Francois-Fraser-Summer	725	L-06-07
	Fraser-Early Summer (EXTINCT)	753	NA
	Harrison-Downstream Migrating-Late	713	L-03-03
	Harrison-Upstream Migrating-Late	714	L-03-04
	Kamloops-Early Summer	740	L-10-01
	Kawkawa-Late (EXTINCT)	758	NA
	Lillooet-Harrison-Late	716	L-04-01

Species	Conservation Unit	CU ID	CU Index
	Momich-Early Summer (EXTINCT)	761	NA
	Nadina-Francois-Early Summer	727	L-06-20
	Nahatlatch-Early Summer	718	L-05-02
	North Barriere-Early Summer (EXTINCT)	763	NA
	North Barriere-Early Summer (de novo)	752	L-10-03
	Pitt-Early Summer	715	L-03-05
	Quesnel-Summer (cyclic)	728	L-06-10
	Seton-Summer (EXTINCT)	759	NA
	Seton-Late (de novo)	729	L-06-11
	Shuswap-Early Summer (cyclic)	738	L-09-02
	Shuswap-Late (cyclic)	739	L-09-03
	Takla-Trembleur-Stuart-Summer (cyclic)	731	L-06-13
	Takla-Trembleur-Early Stuart	732	L-06-14
	Taseko-Early Summer	734	L-06-16
Sockeye (river-type)	Harrison River	745	R03
	Widgeon	742	R02

Vancouver Island and Mainland Inlets Region

Table A. 5. Conversation Units in the Vancouver Island & Mainland Inlets Region (n=87), listed by species.
Overview of the number of CUs by species: 14 Chinook, 9 chum, 10 coho, 4 pink (even-year), 6 pink (odd-year), 40 sockeye (lake-type), and 4 sockeye (river-type) for a total of 87 CUs. The CU names and indexes are based on Holtby and Ciruna (2007).

Species	Conservation Unit	CU ID	CU Index
Chinook	East Vancouver Island-Cowichan and Koksilah (Fall X1)	322	22
	East Vancouver Island-Georgia Strait (Summer 41)	334	83
	East Vancouver Island-Goldstream (Fall X1)	321	21
	East Vancouver Island-Nanaimo (Spring X2)	324	25
	East Vancouver Island-Nanaimo and Chemainus (Fall X1)	323	23
	East Vancouver Island-North (Fall X1)	327	29
	East Vancouver Island-Qualicum and Puntledge (Fall X1)	325	27
	Homathko (Summer Xx)	331	34
	Klinaklini (Summer 52)	332	35
	Southern Mainland-Georgia Strait (Fall X1)	320	20
	Southern Mainland-Southern Fjords (Fall X1)	326	28
	West Vancouver Island-Nootka and Kyuquot (Fall X1)	329	32
	West Vancouver Island-North (Fall X1)	330	33
	West Vancouver Island-South (Fall X1)	328	31
Chum	Bute Inlet	901	7
	Georgia Strait	904	4
	Howe Sound-Burrard Inlet	905	3

Species	Conservation Unit	CU ID	CU Index
	Loughborough	902	6
	Northeast Vancouver Island	903	5
	Northwest Vancouver Island	977	11
	Southern Coastal Streams	900	8
	Southwest & West Vancouver Island	978	10
	Upper Knight	979	9
Coho	Clayoquot	915	18
	East Vancouver Island-Georgia Strait	910	13
	East Vancouver Island-Johnstone Strait-Southern Fjords	911	14
	Georgia Strait Mainland	908	11
	Homathko-Klinaklini Rivers	916	19
	Howe Sound-Burrard Inlet	907	10
	Juan de Fuca-Pachena	913	16
	Nahwitti Lowland	912	15
	Southern Coastal Streams-Queen Charlotte Strait-Johnstone Strait-Southern Fjords	909	12
	West Vancouver Island	914	17
Pink (even-year)	Georgia Strait	917	1
	Northwest Vancouver Island	919	3
	Southern Fjords	920	4
	West Vancouver Island	918	2
Pink (odd-year)	East Howe Sound-Burrard Inlet	921	2
	East Vancouver Island-Johnstone Strait	923	4
	Georgia Strait	922	3
	Nahwitti	924	5
	Southern Fjords	926	7

Species	Conservation Unit	CU ID	CU Index
	West Vancouver Island	925	6
Sockeye (lake-type)	Alice	945	L-13-01
	Canoe Creek	946	L-13-02
	Cecilia	947	L-13-03
	Cheewat	948	L-13-04
	Clayoquot	949	L-13-05
	Deserted	950	L-13-06
	Fairy	951	L-13-07
	Fulmore	927	L-11-01
	Great Central	952	L-13-08
	Henderson	953	L-13-09
	Hesquiat	954	L-13-10
	Heydon	928	L-11-02
	Hobiton	955	L-13-11
	Ida-Bonanza	937	L-12-01
	Jansen	956	L-13-12
	Kakweiken	929	L-11-03
	Kanim	957	L-13-13
	Kennedy	958	L-13-14
	Loose	930	L-11-04
	Mackenzie	931	L-11-05
	Maggie	959	L-13-15
	Megin	960	L-13-16
	Muchalat	961	L-13-17
	Muriel	962	L-13-18
	Nahwitti	938	L-12-02
	Nimpkish	939	L-12-03

Species	Conservation Unit	CU ID	CU Index
	Nitinat	963	L-13-19
	O'Connell	964	L-13-20
	Park River	966	L-13-22
	Phillips	932	L-11-06
	Power	967	L-13-23
	Quatse	941	L-12-05
	Sakinaw	933	L-11-07
	Schoen	942	L-12-06
	Shushartie	943	L-12-07
	Sproat	969	L-13-25
	Tzoonie	935	L-11-09
	Vernon	976	L-12-09
	William-Brink	970	L-13-26
	Woss	944	L-12-08
Sockeye (river-type)	East Vancouver Island & Georgia Strait	973	R08
	NW Vancouver Island	974	R11
	Southern Fjords	971	R09
	West Vancouver Island	972	R10

Haida Gwaii

Table A. 6. Conversation Units in Haida Gwaii (n=29), listed by species. Overview of the number of CUs by species: 2 Chinook, 5 chum, 3 coho, 3 pink (even-year), 3 pink (odd-year), 10 sockeye (lake-type), and 3 sockeye (river-type). The CUs Names and Index are based on Holtby and Ciruna (2007).

Species	Conservation Unit	CU ID	CU Index
Chinook	North Haida Gwaii	805	44
	East Haida Gwaii	806	43
Chum	North Haida Gwaii-Stanley Creek	800	25
	East Haida Gwaii	801	21
	North Haida Gwaii	802	24
	West Haida Gwaii	803	23
	Skidegate	804	22
Coho	East Haida Gwaii	807	23
	West Haida Gwaii	808	24
	Graham Island Lowlands	809	25
Pink (even-year)	North Haida Gwaii	810	9
	East Haida Gwaii	811	10
	West Haida Gwaii	812	11
Pink (odd-year)	East Haida Gwaii	813	9
	North Haida Gwaii	814	10
	West Haida Gwaii	815	11
Sockeye (lake-type)	Ain/Skundale/Ian	819	L-17-01
	Awun	820	L-17-02
	Fairfax	821	L-17-03
	Jalun	822	L-17-04
	Marian/Eden	823	L-17-05
	Mathers	824	L-17-06

	Mercer	825	L-17-07
	Skidegate	826	L-17-08
	Yakoun	827	L-17-09
	Marie	828	n/a
Sockeye (river-type)	East Haida Gwaii	816	R13
	North Haida Gwaii	817	R15
	West Haida Gwaii	818	R14

Columbia

Table A. 7. Conversation Units in the Columbia Region (n=2), listed by species. Overview of the number of CUs by species: one Chinook, one sockeye (lake-type). The CUs Names and Index are based on Holtby and Ciruna (2007) and subsequent updates provided by DFO.

Species	Conservation Unit	CU ID	CU Index
Chinook	Okanagan	301	1
Sockeye (lake-type)	Osoyoos	1300	L-1-1

* No CUs are defined for chum, coho, pink (even-year), pink (odd-year) or sockeye (river-type) in the Columbia region.

Appendix 2: Conservation Unit Maps by Region and Species

Skeena Region

Sockeye

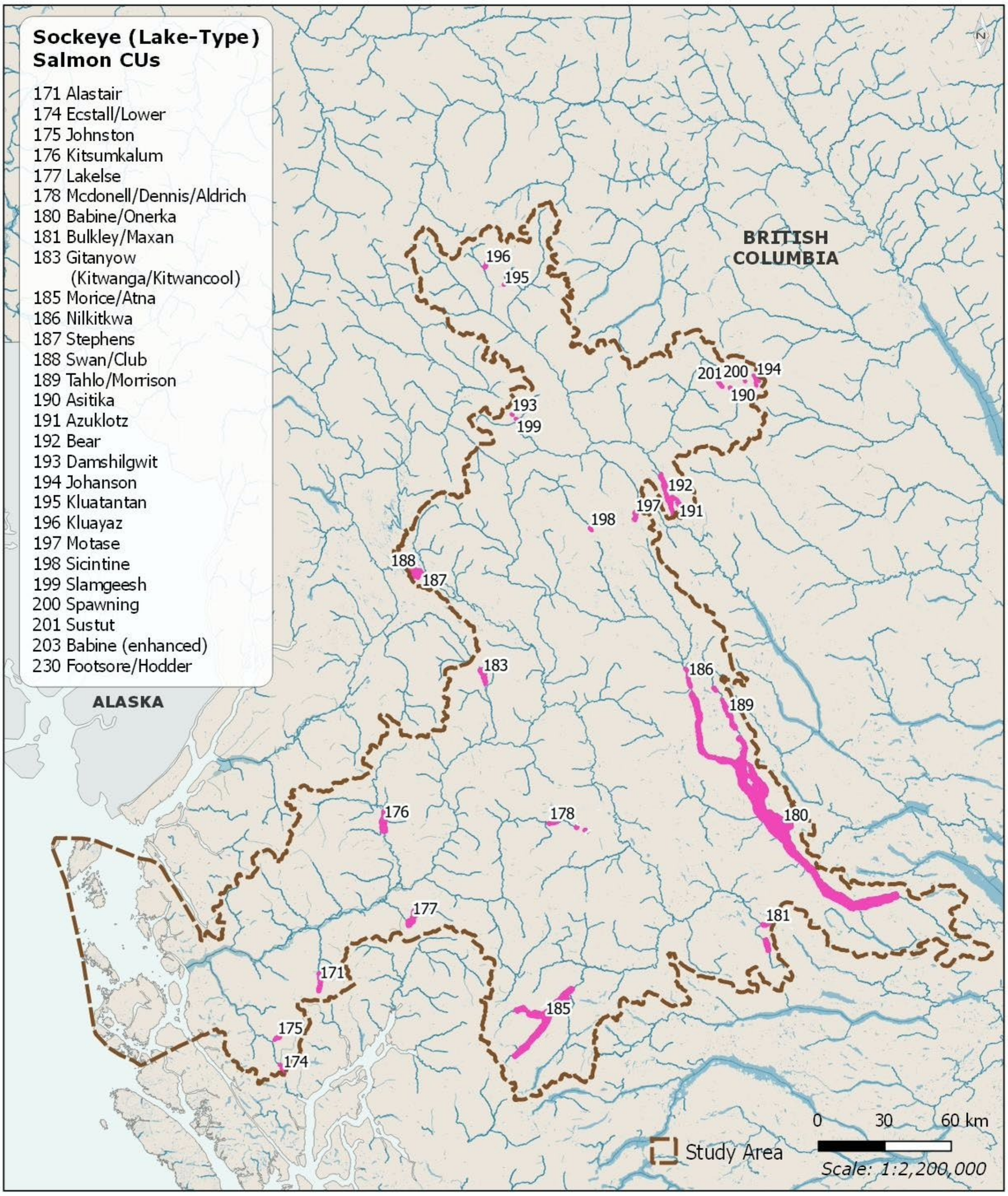

Figure A.1. Sockeye (lake-type) salmon CUs within the Skeena Region.

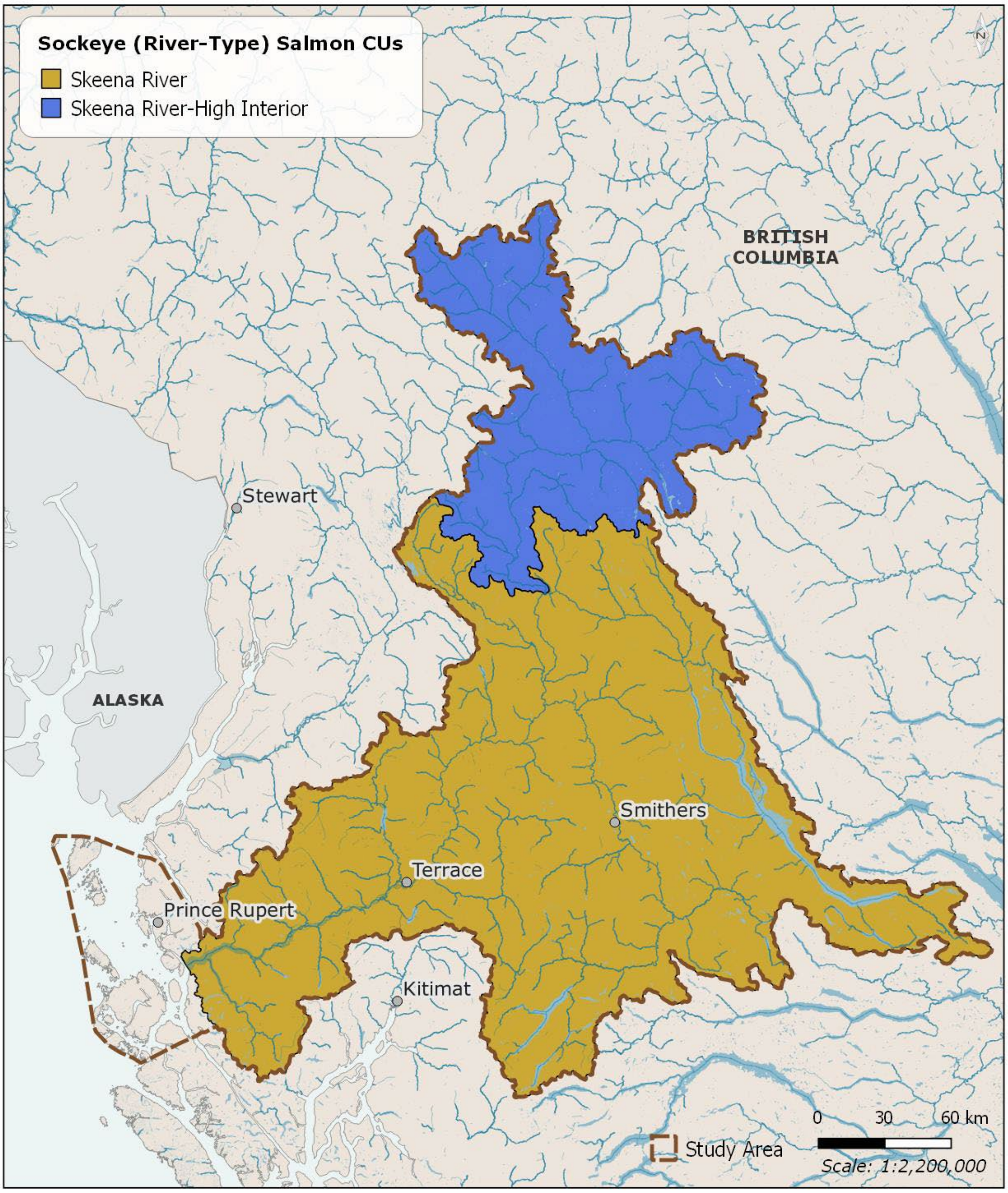

Figure A.2. Sockeye (river-type) salmon CUs within the Skeena Region.

Pink

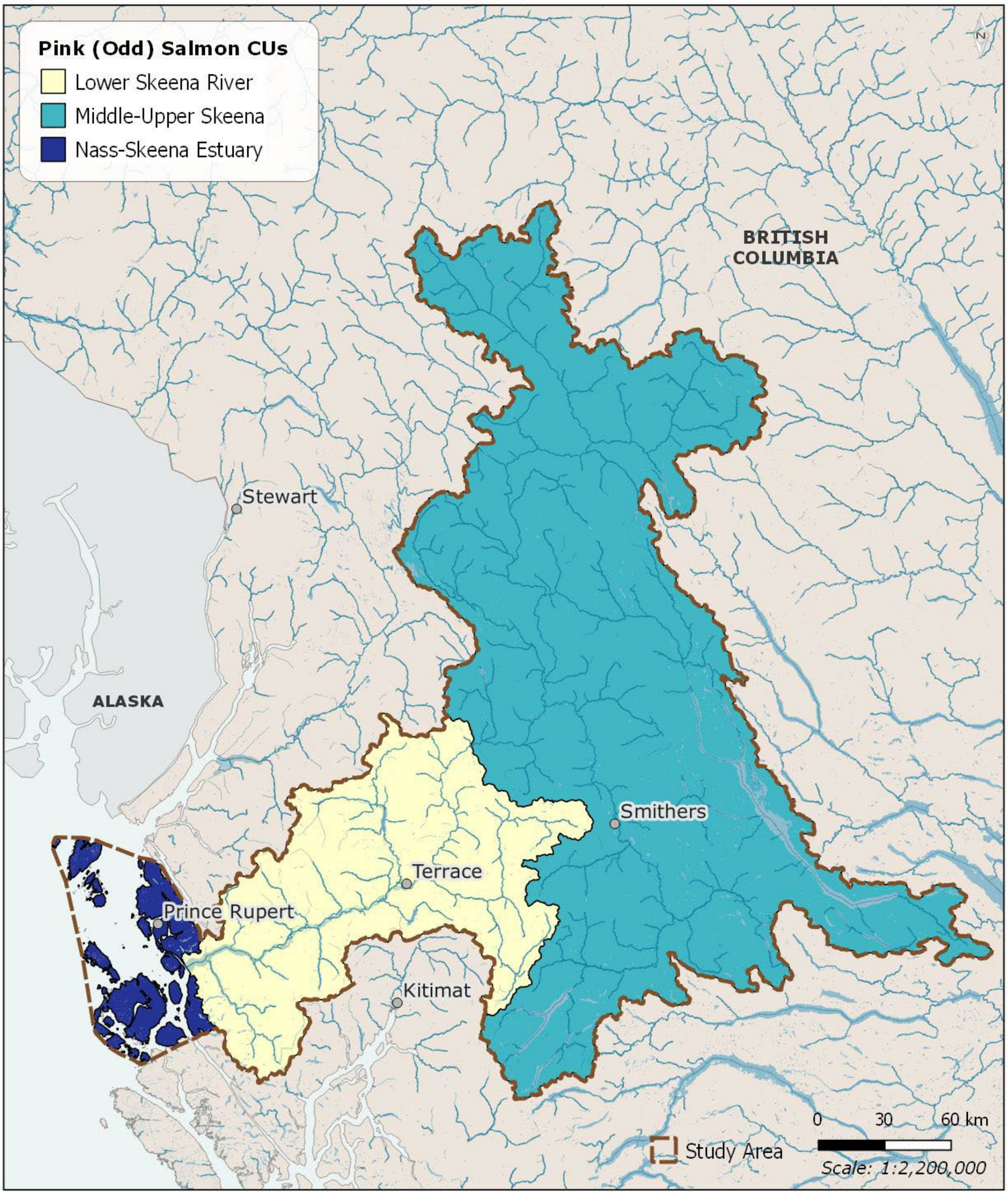

Figure A.3. Pink (odd) salmon CUs in the Skeena Region.

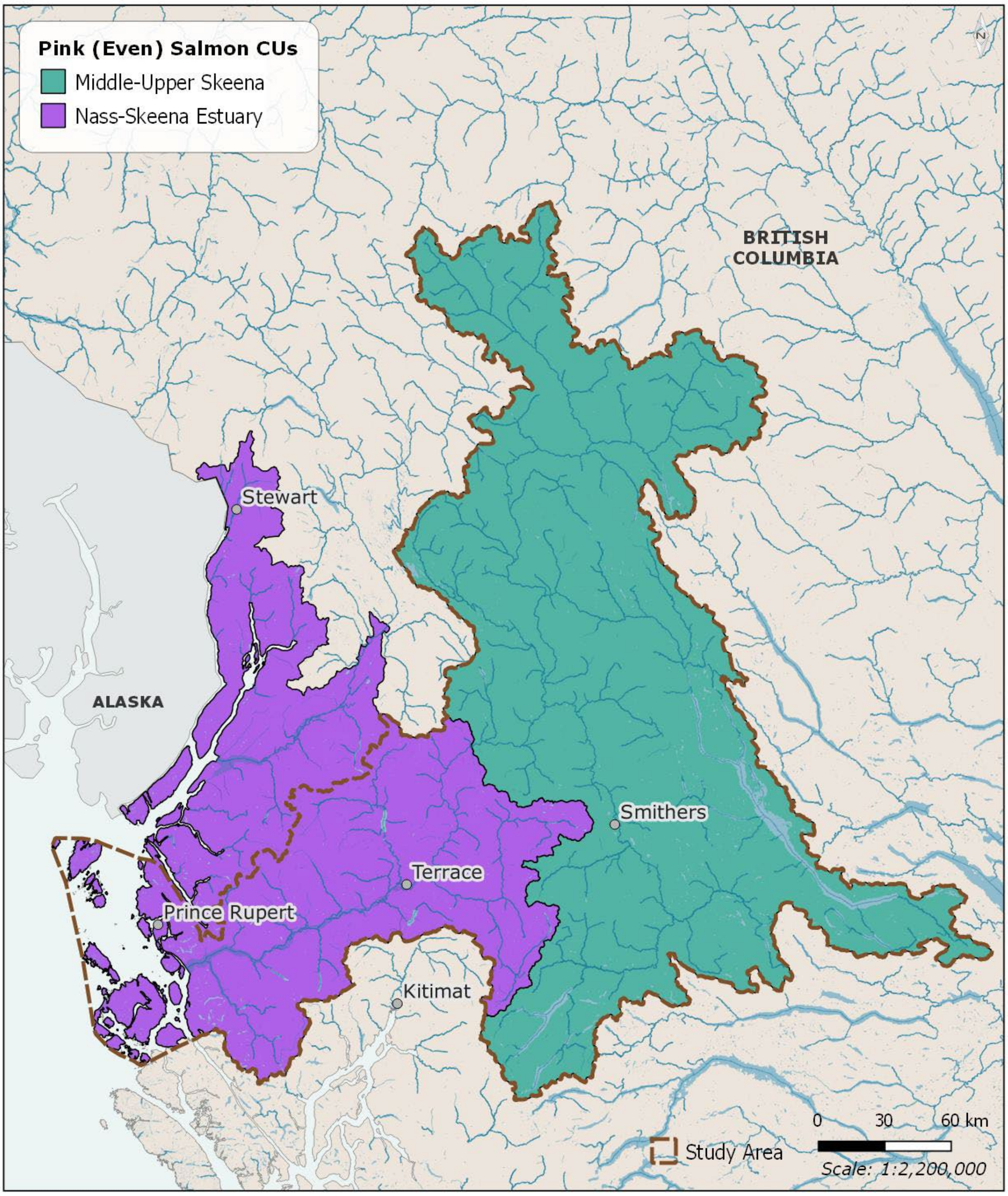

Figure A.4. Pink (even) salmon CUs in the Skeena Region.

Chinook

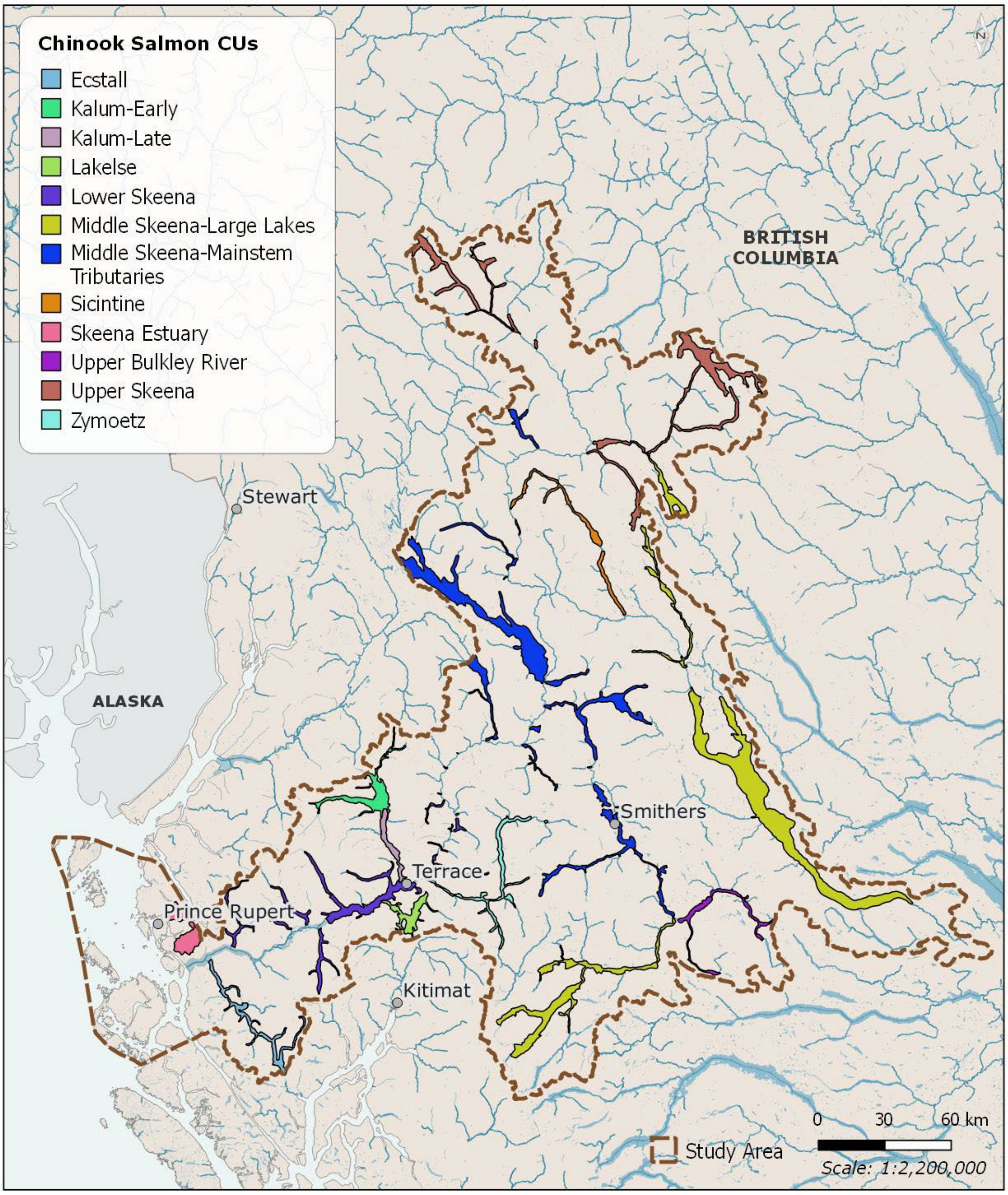

Figure A.5. Chinook salmon CUs in the Skeena Region.

Chum

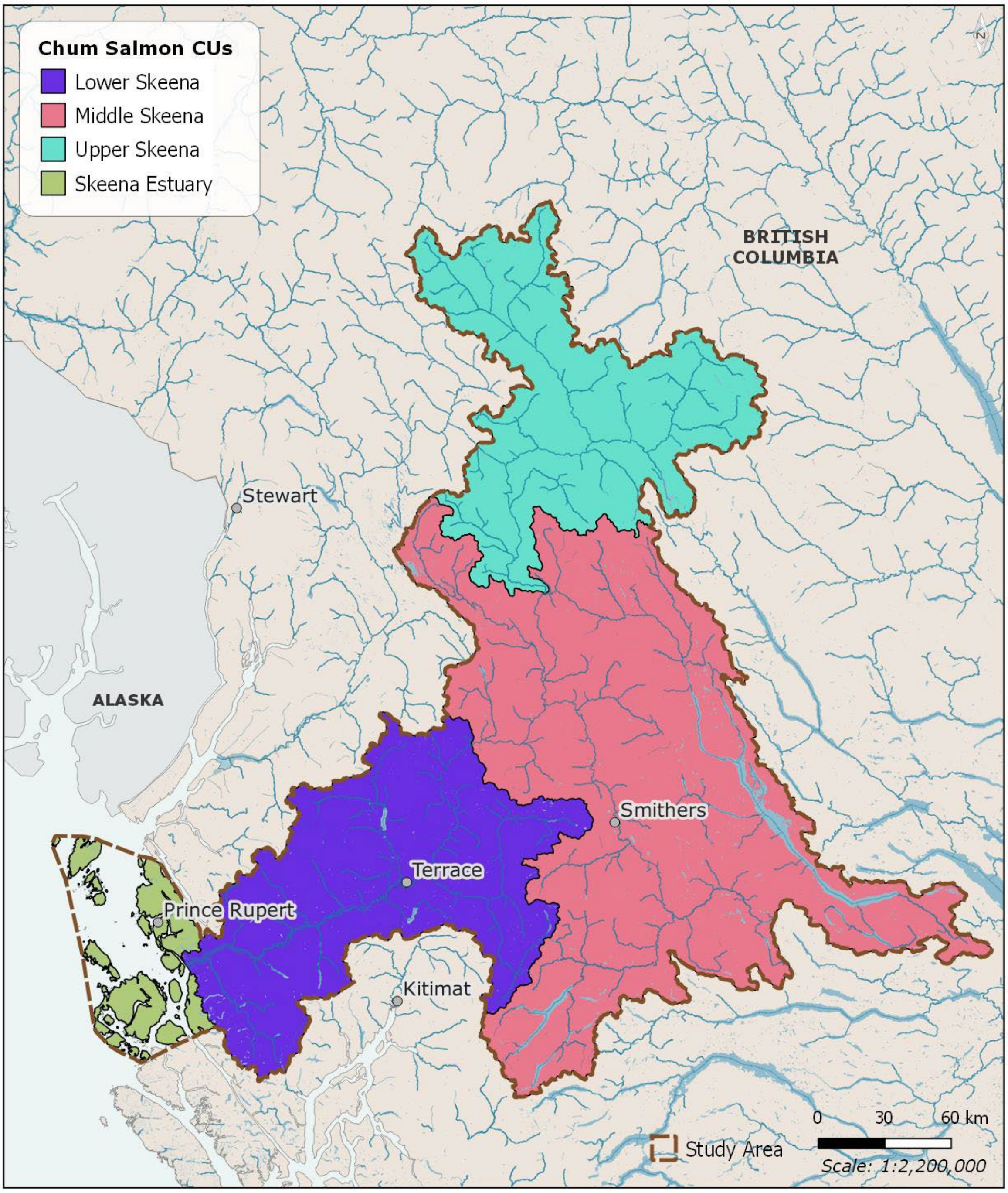

Figure A.6. Chum salmon CUs in the Skeena Region.

Coho

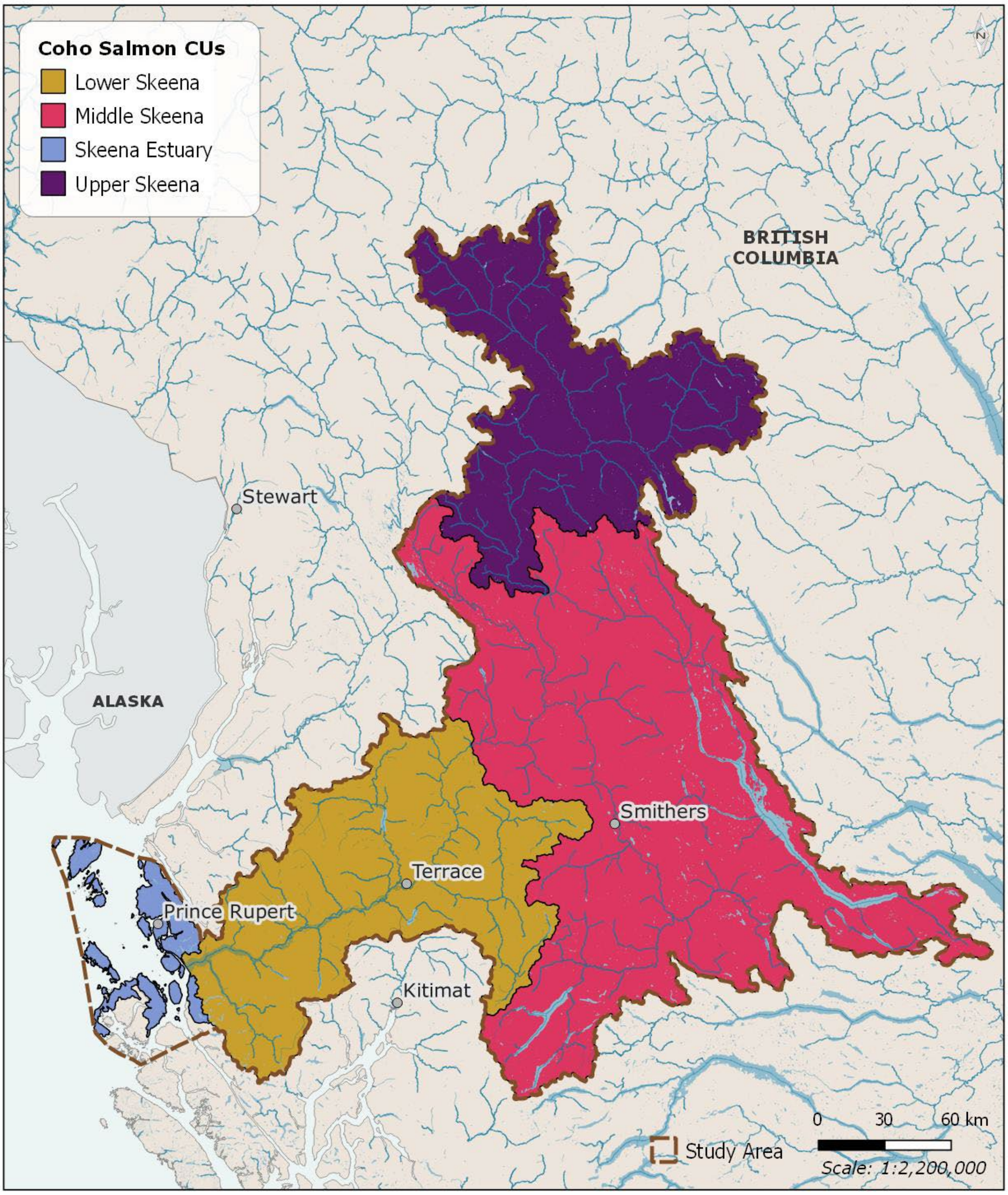

Figure A.7. Coho salmon CUs in the Skeena Region.

Nass Region

Sockeye

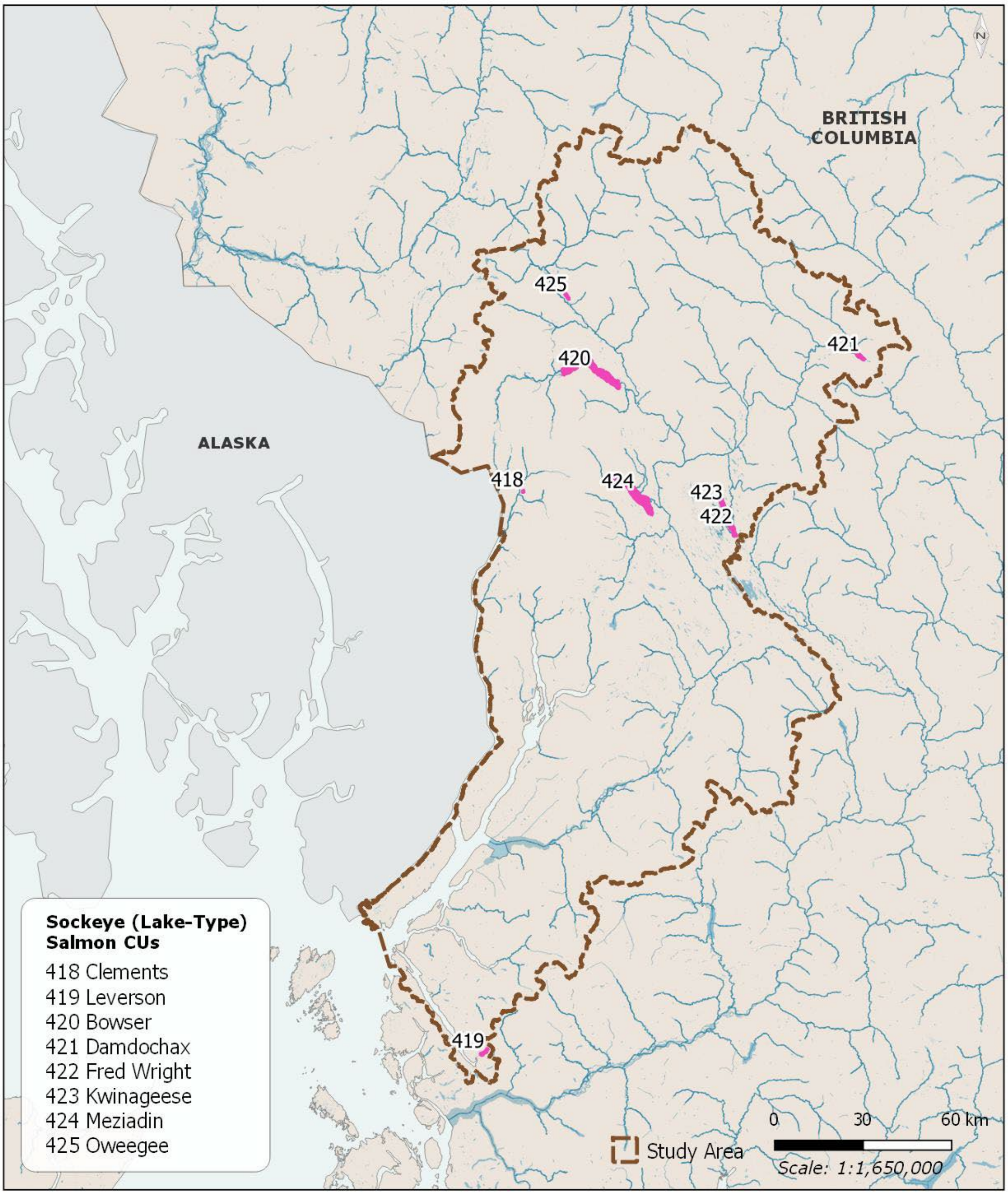

Figure A.8. Sockeye (lake-type) salmon CUs in the Nass Region.

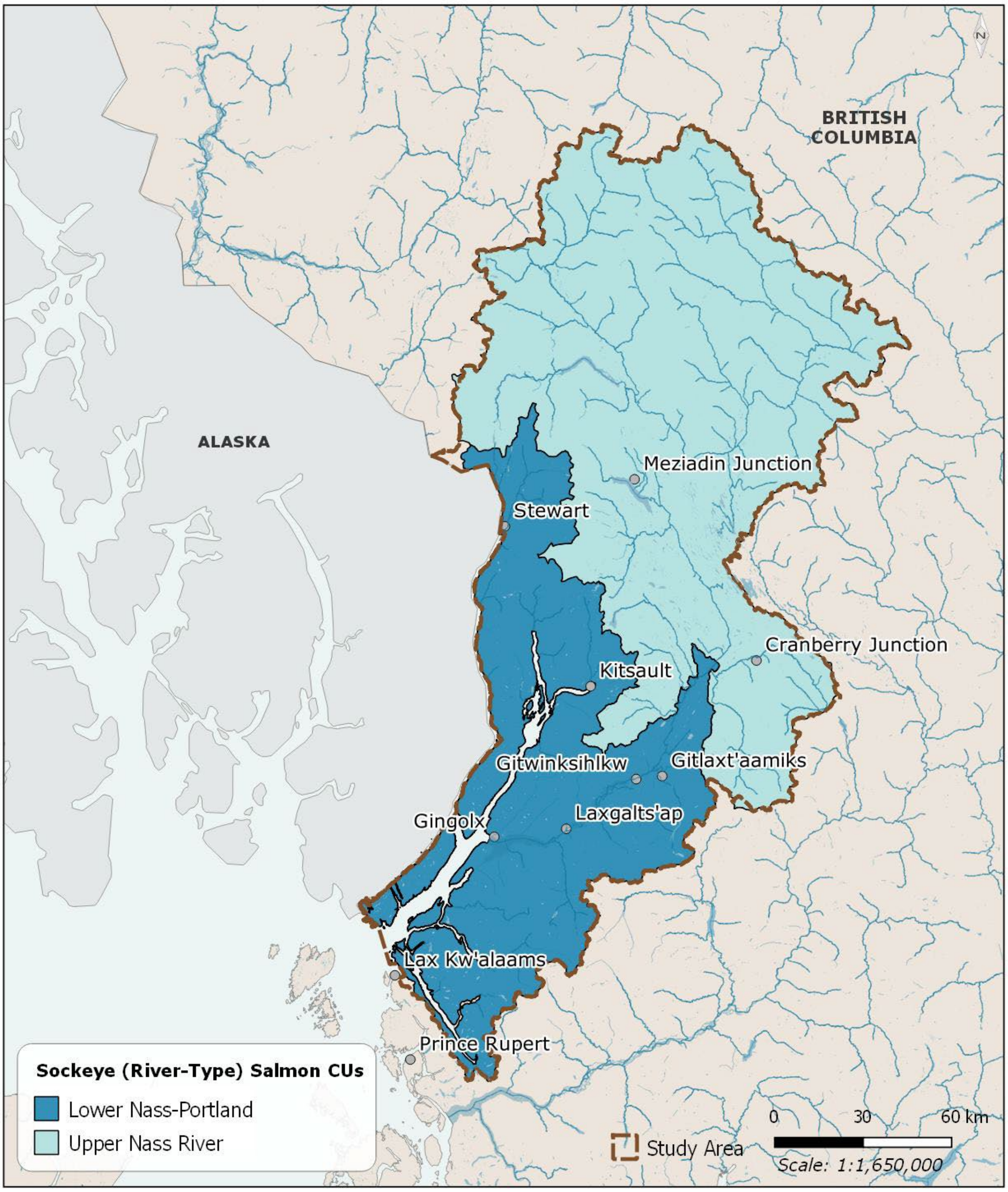

Figure A.9. Sockeye (river-type) salmon CUs in the Nass Region.

Pink

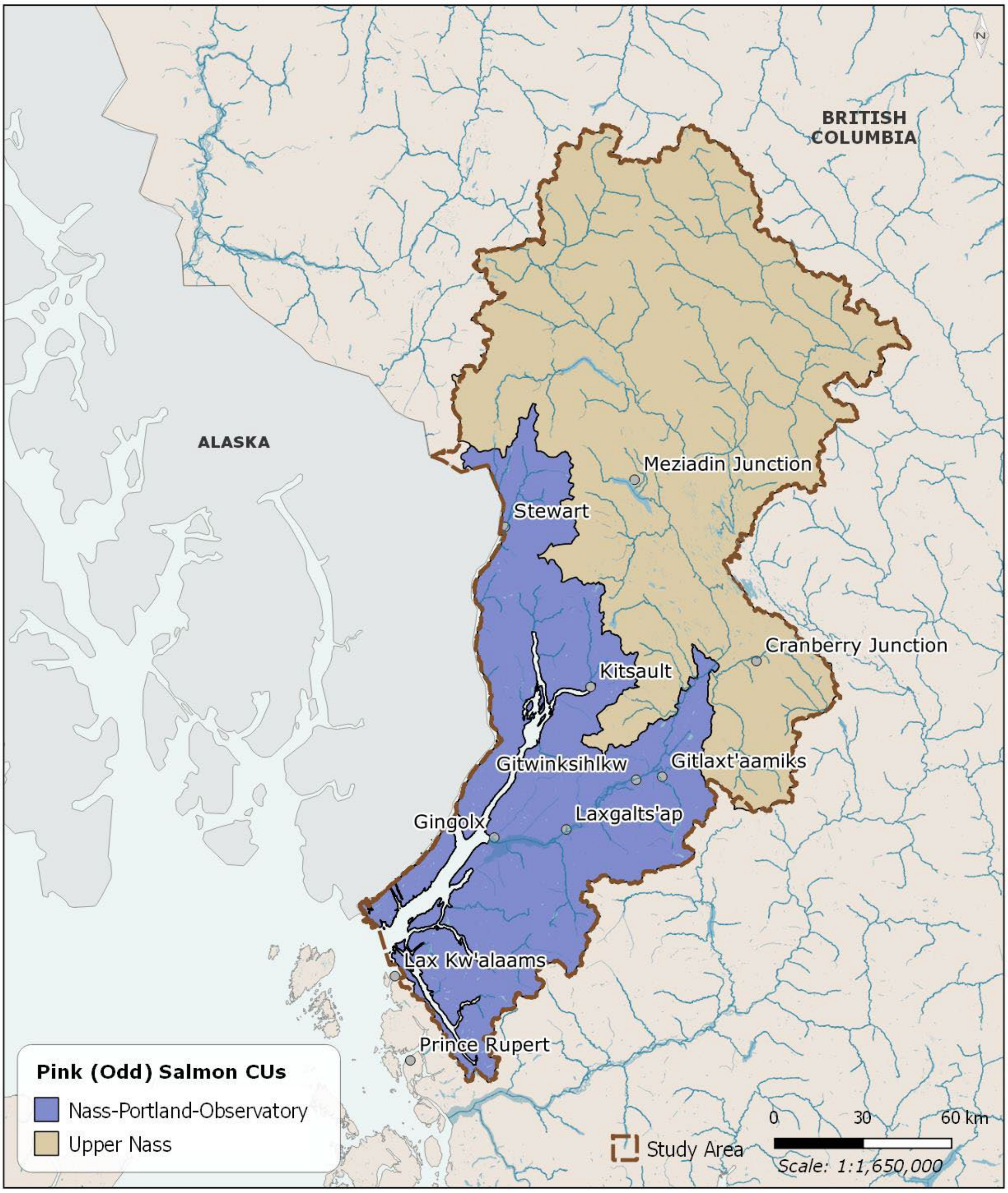

Figure A.10. Pink (odd) salmon CUs in the Nass Region.

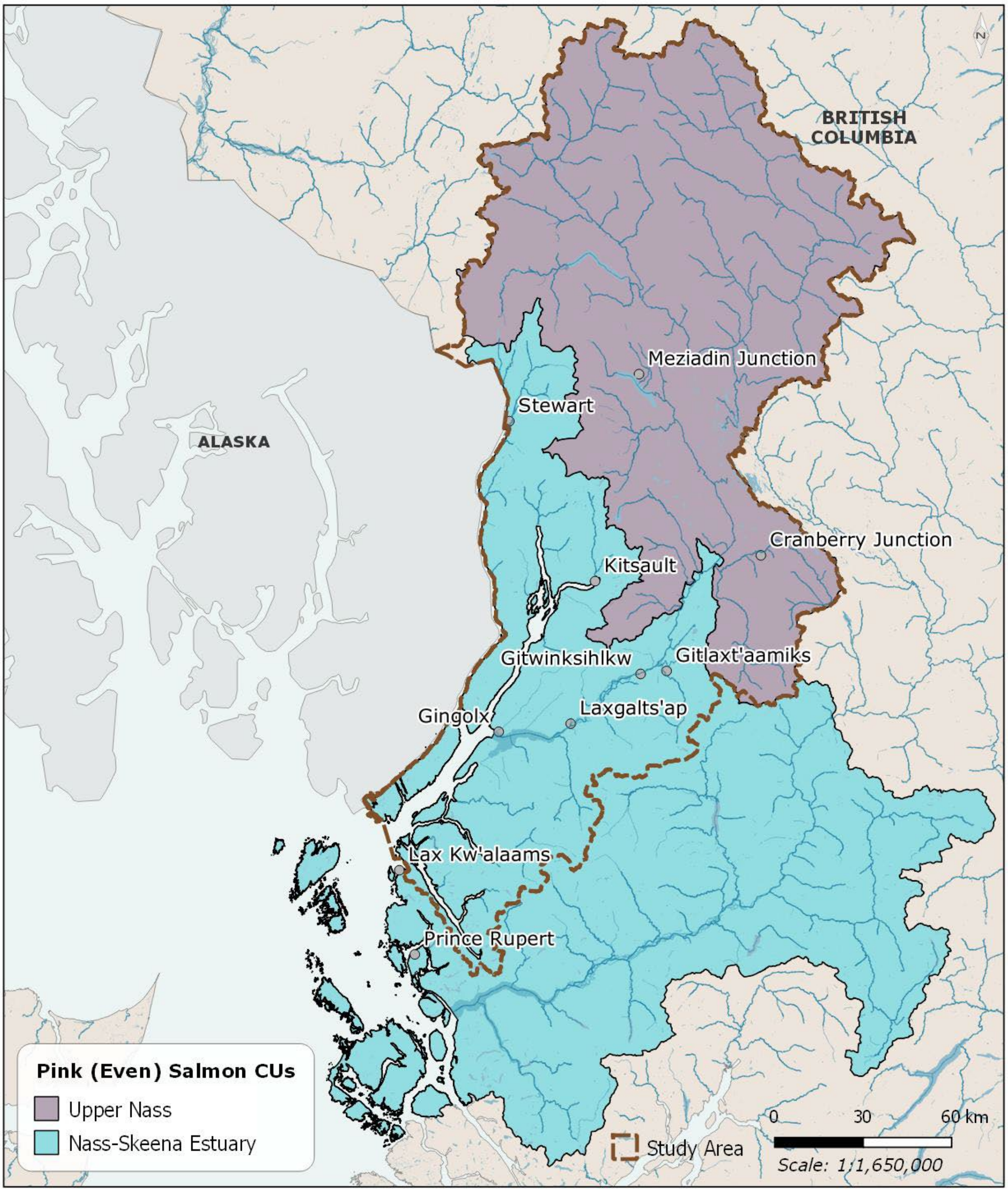

Figure A.11. Pink (even) salmon CUs in the Nass Region.

Chinook

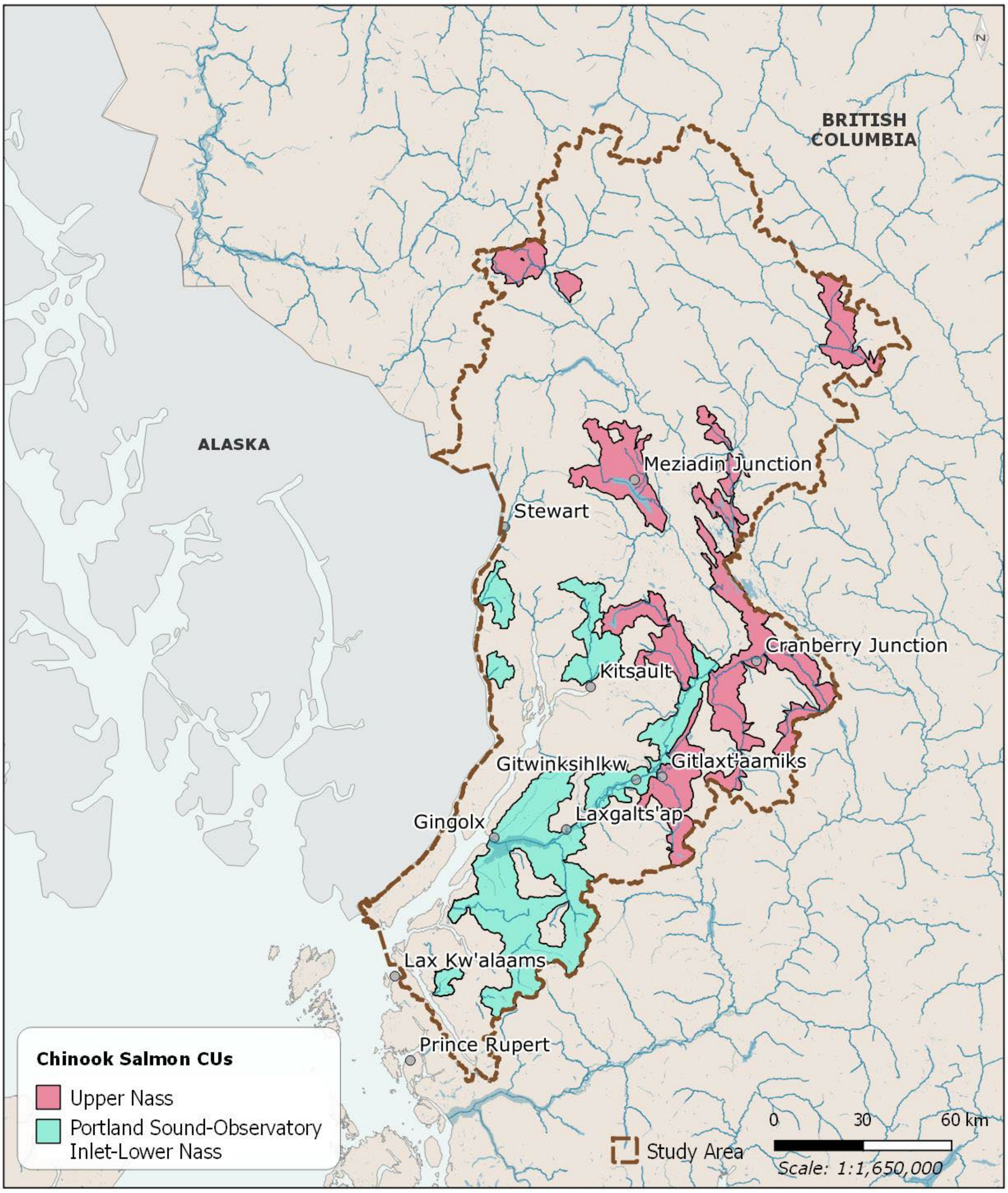

Figure A.12. Chinook salmon CUs in the Nass Region.

Chum

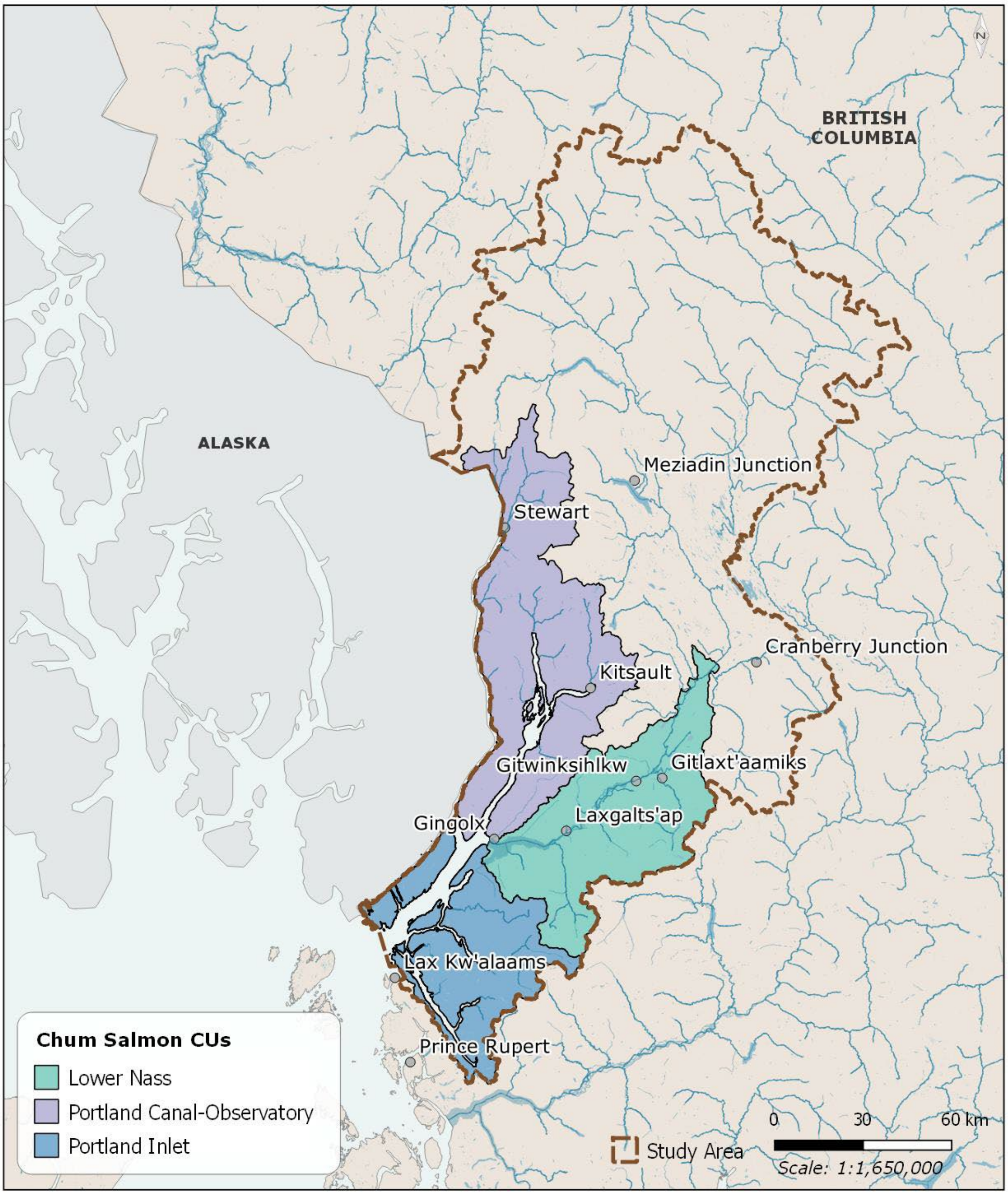

Figure A.13. Chum salmon CUs in the Nass Region.

Coho

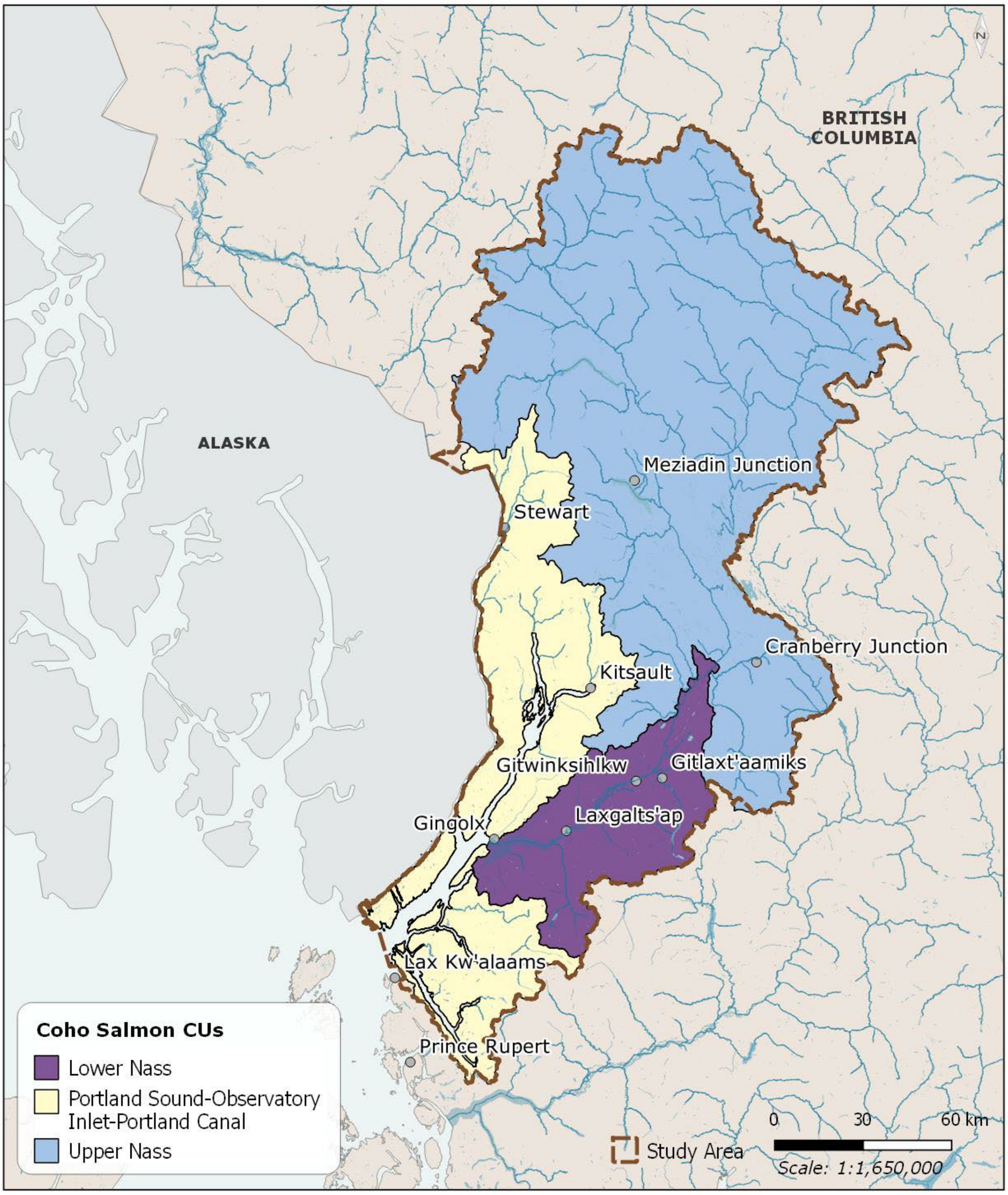

Figure A.14. Coho salmon CUs in the Nass Region.

Central Coast Region

Sockeye

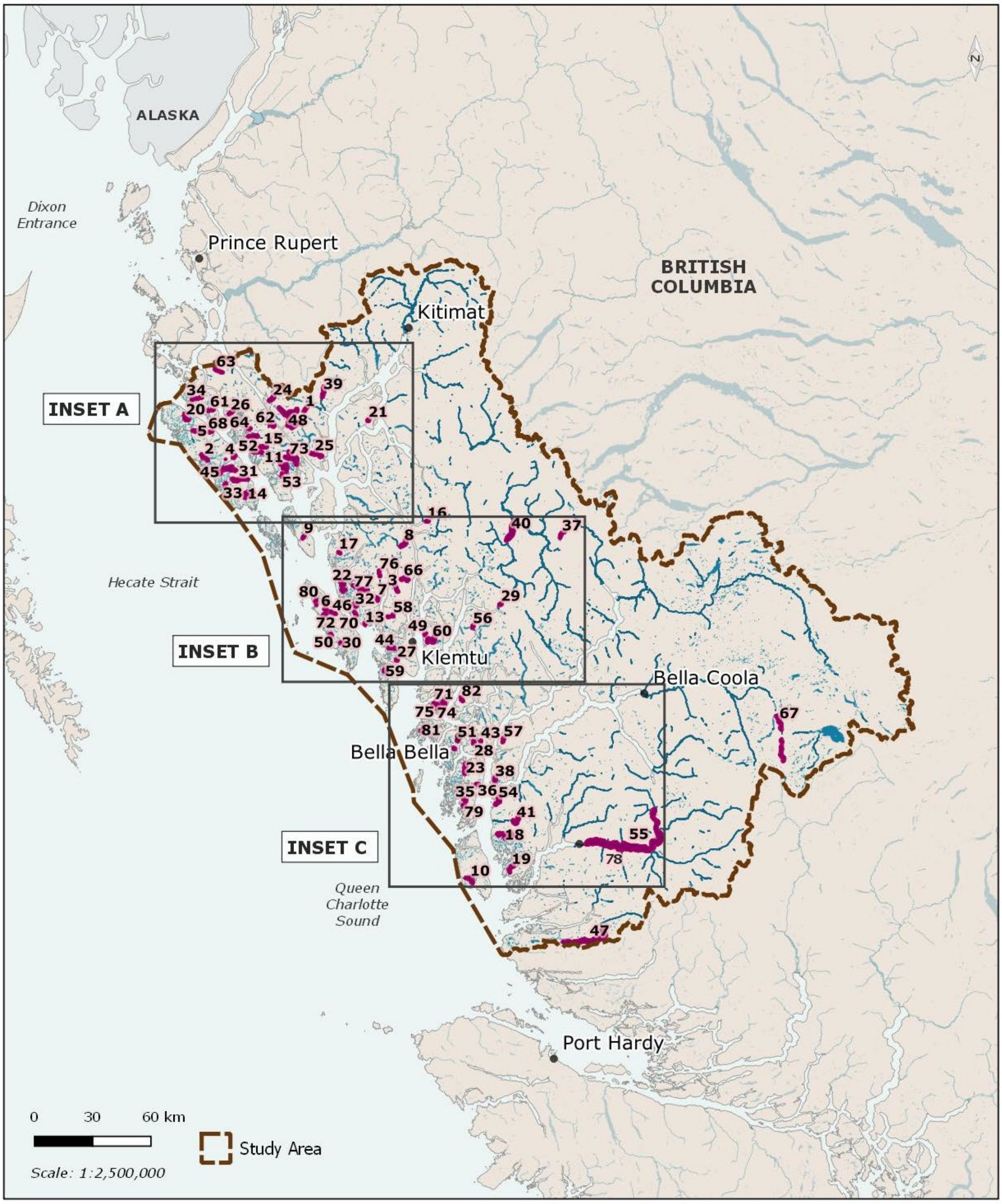

Figure A.15. Regional overview of sockeye (lake-type) salmon CUs in the Central Coast Region.

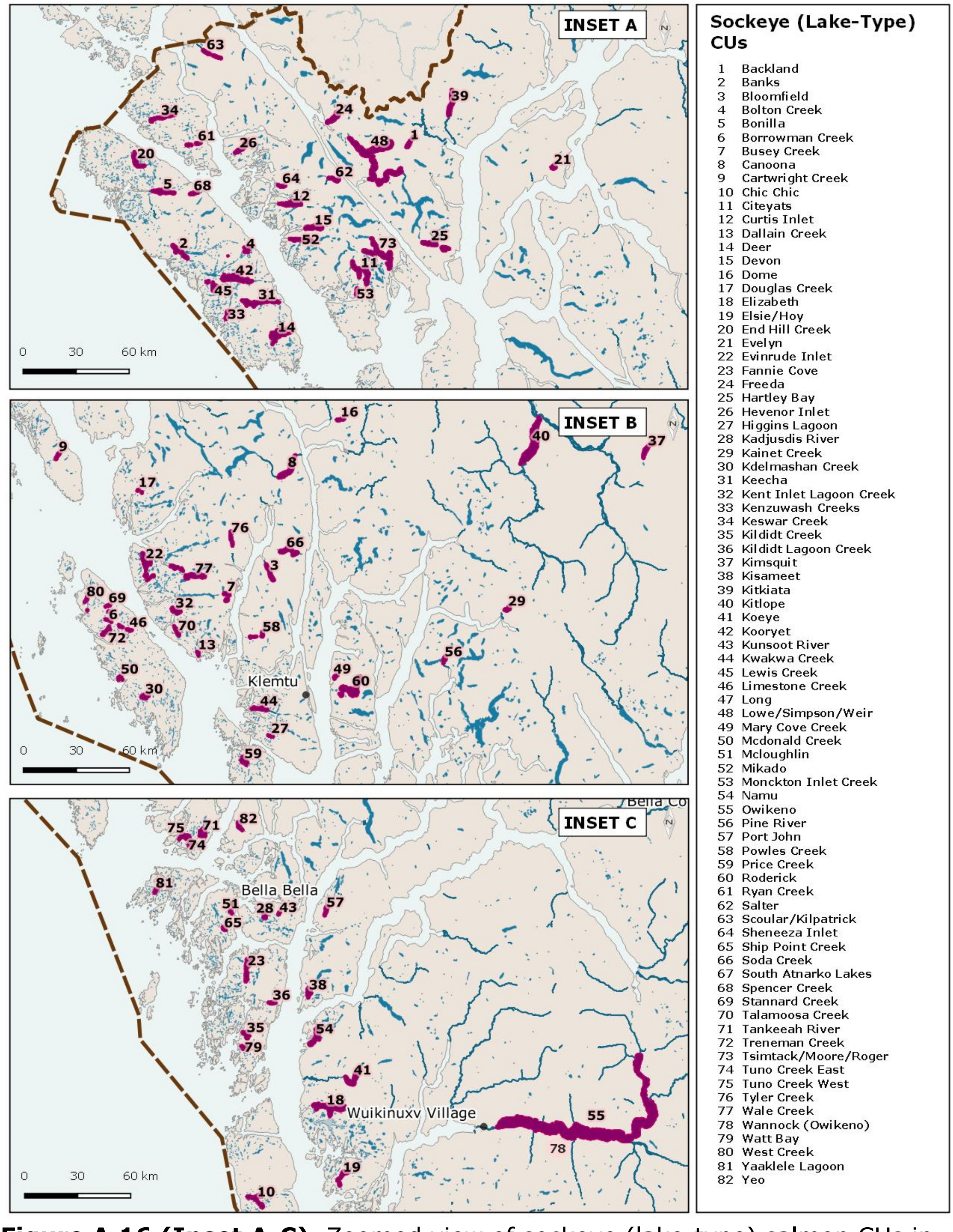

Figure A.16 (Inset A-C). Zoomed view of sockeye (lake-type) salmon CUs in the Central Coast Region.

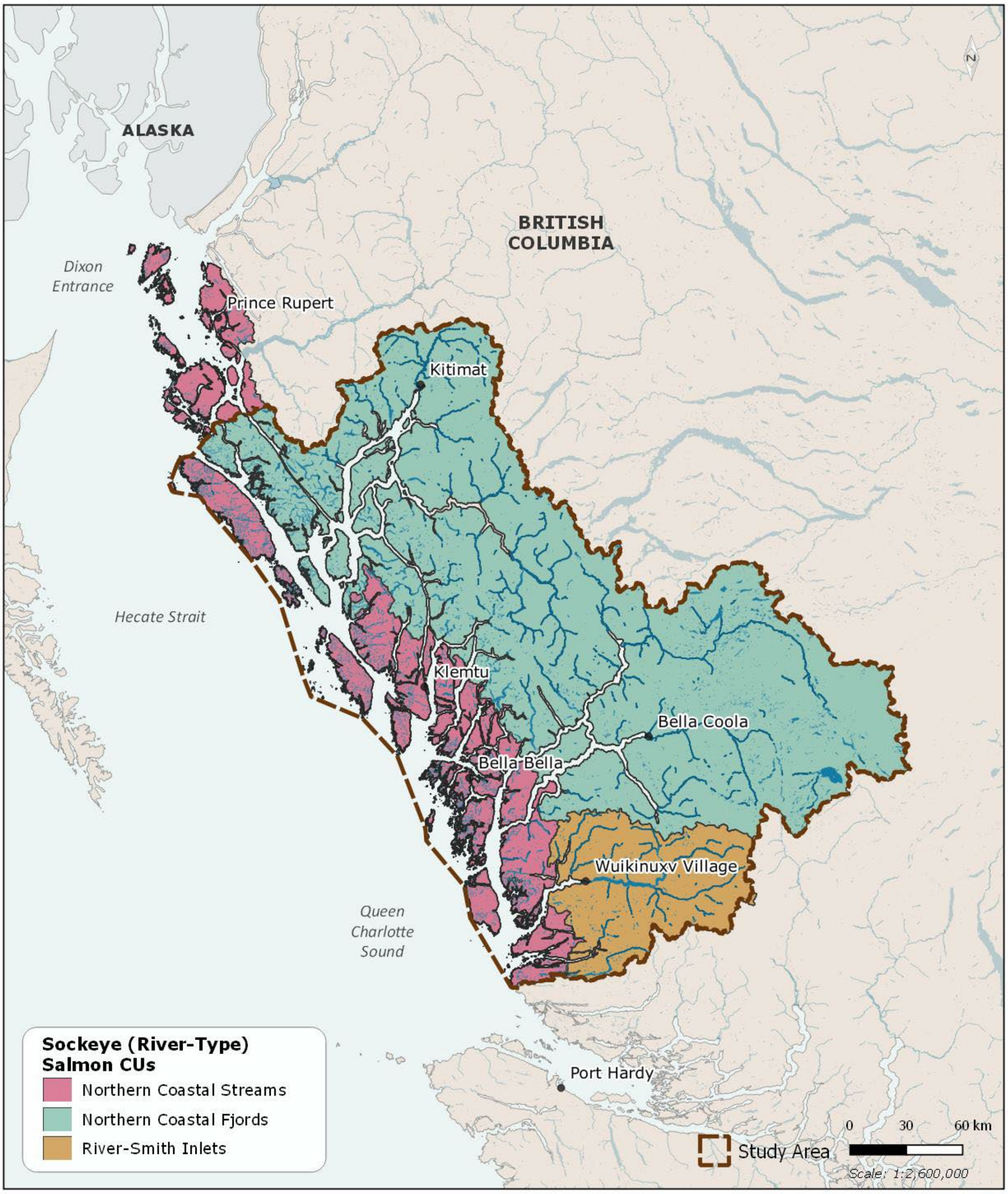

Figure A.17. Sockeye (river-type) salmon CUs in the Central Coast Region.

Pink

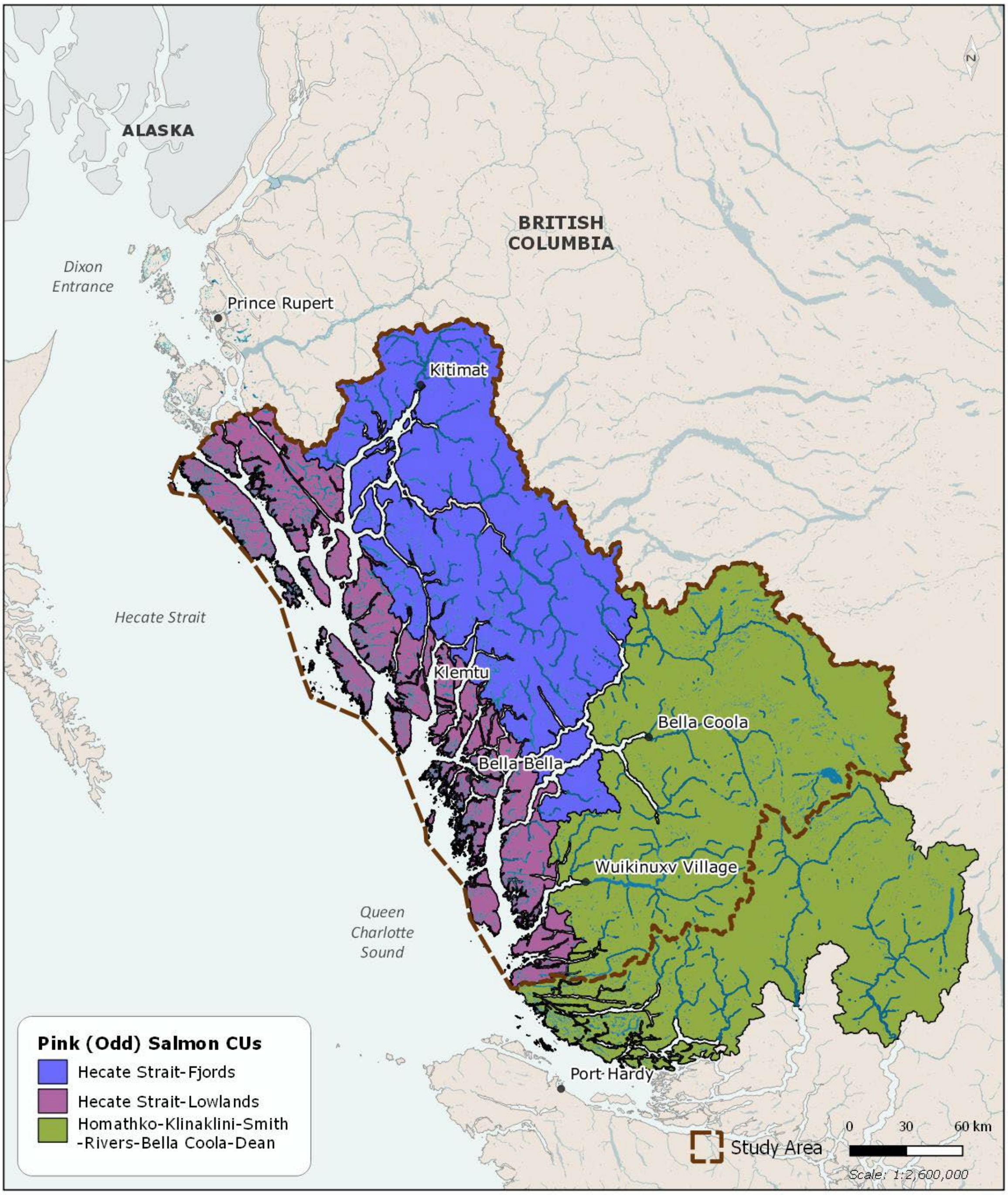

Figure A.18. Pink (odd) salmon CUs in the Central Coast Region.

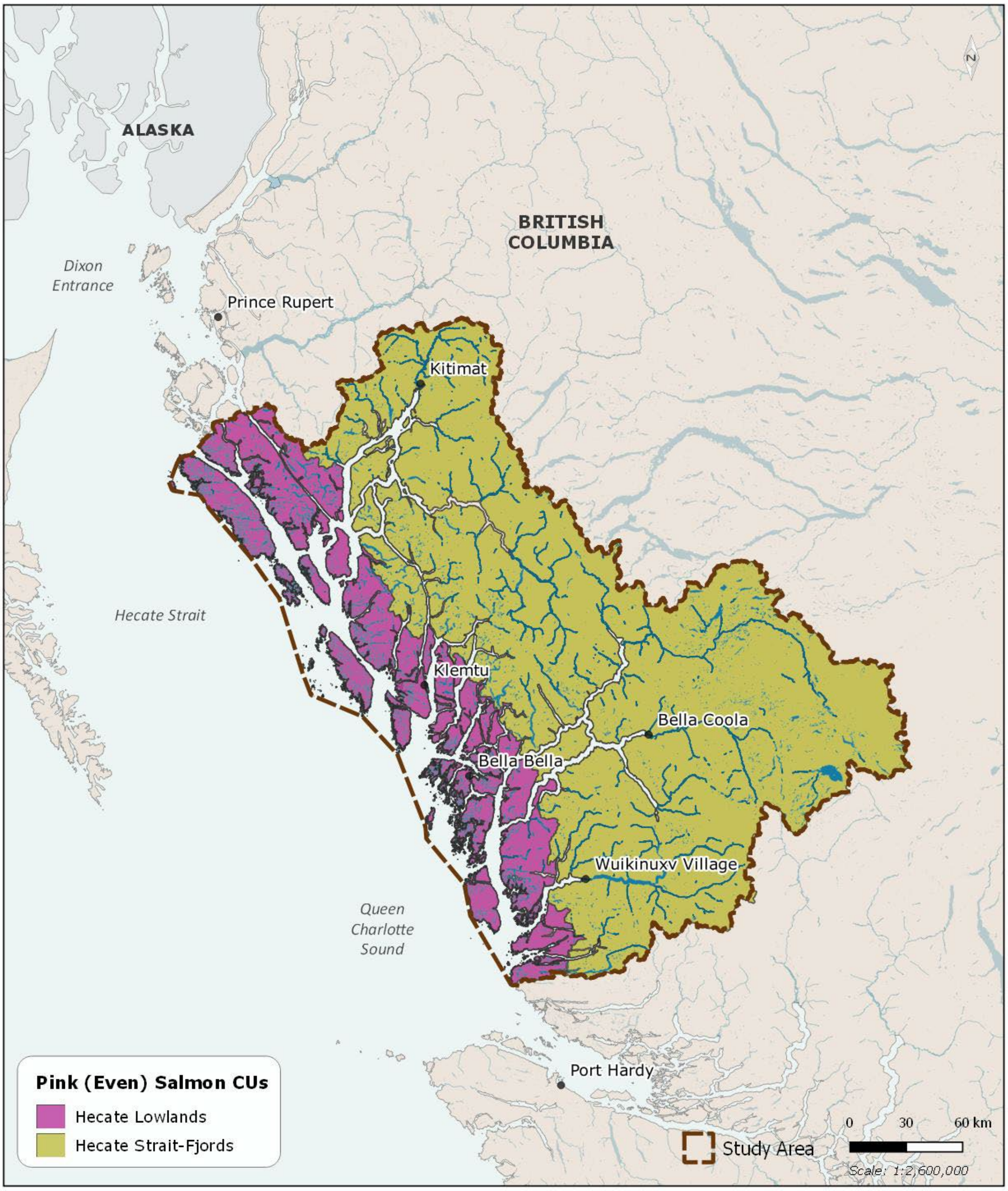

Figure A.19. Pink (even) salmon CUs in the Central Coast Region.

Chinook

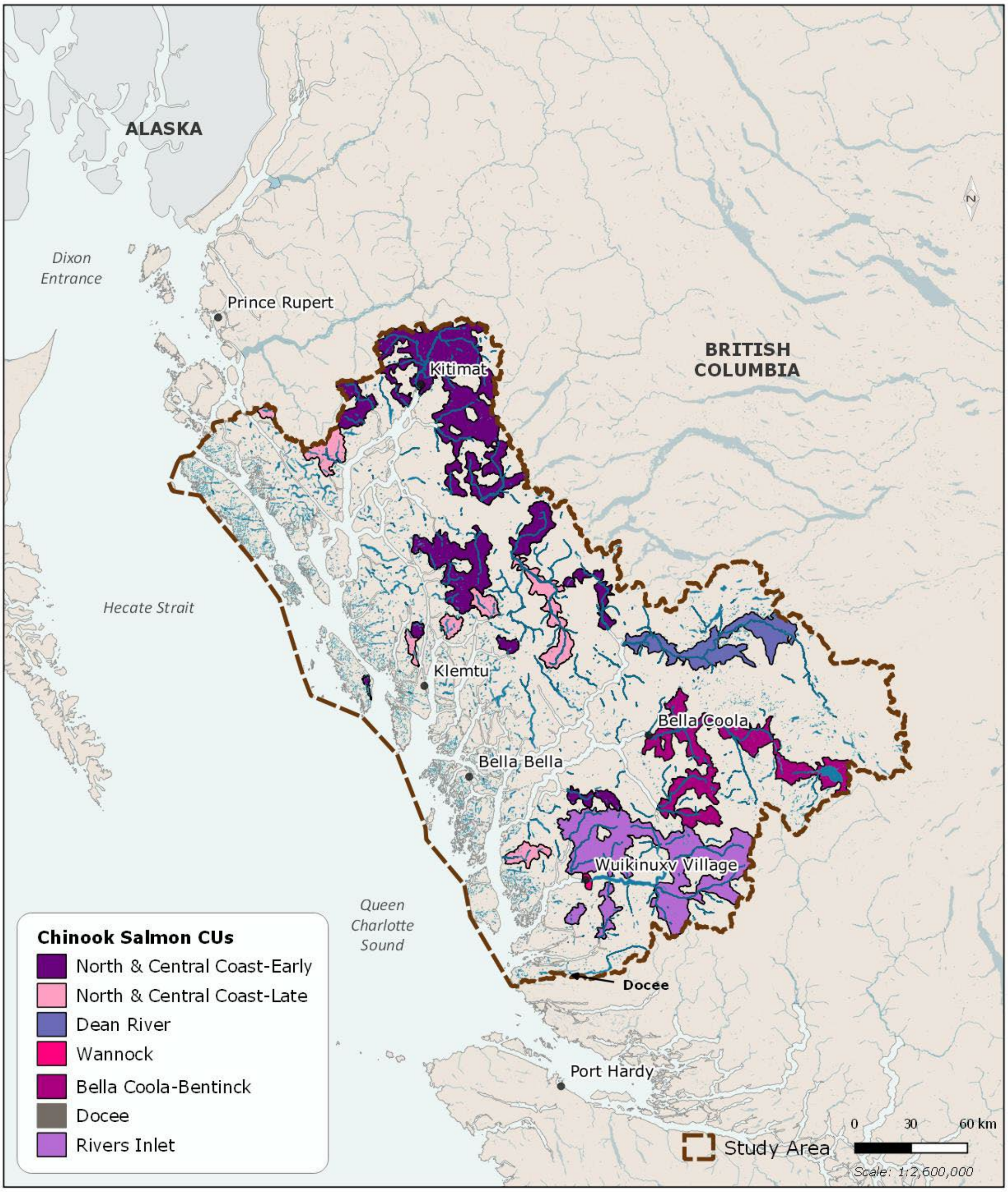

Figure A.20. Chinook Salmon CUs in the Central Coast Region.

Chum

Figure A.21. Chum Salmon CUs in the Central Coast Region.

Coho

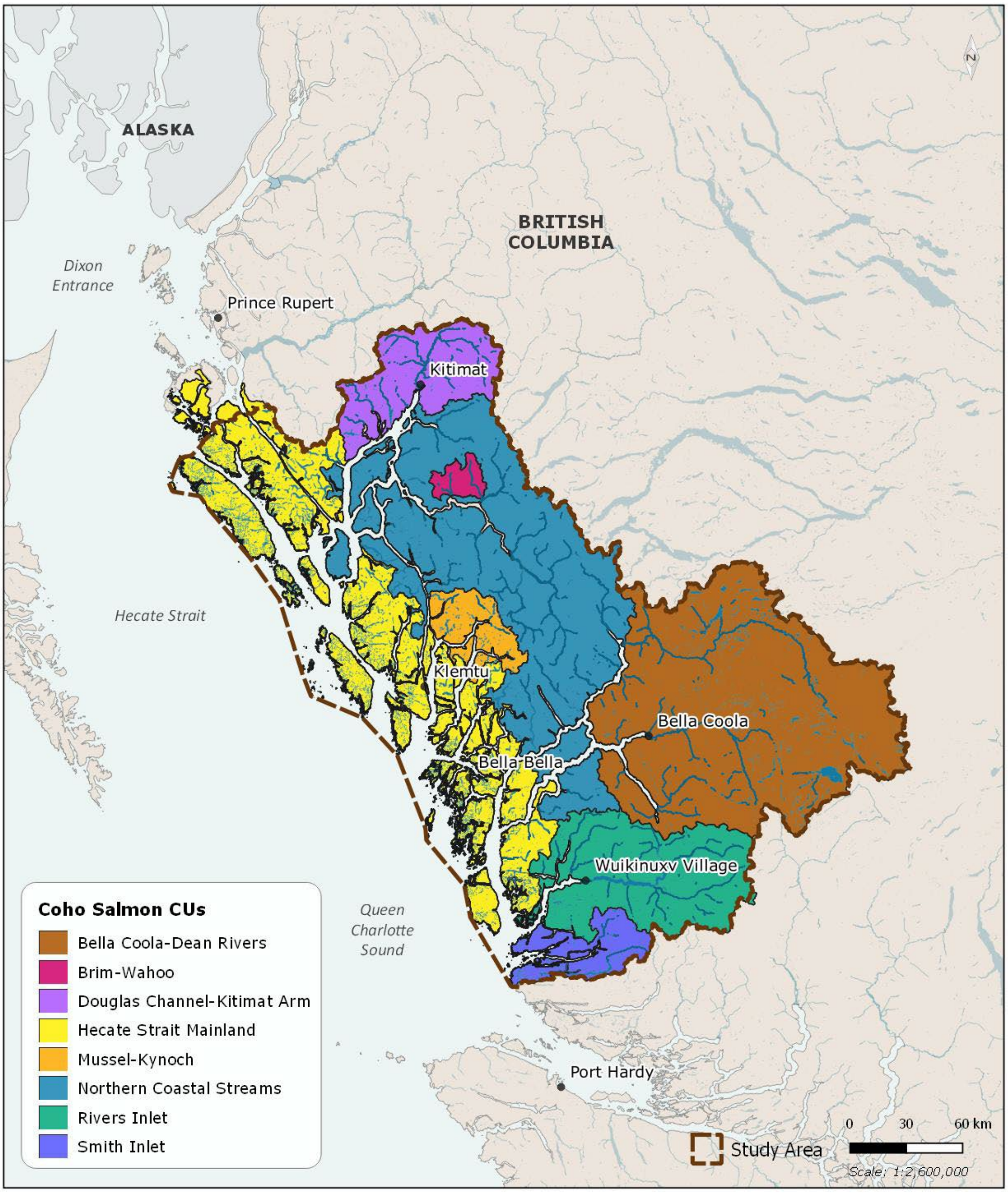

Figure A.22. Coho Salmon CUs in the Central Coast Region.

Fraser Region

Sockeye

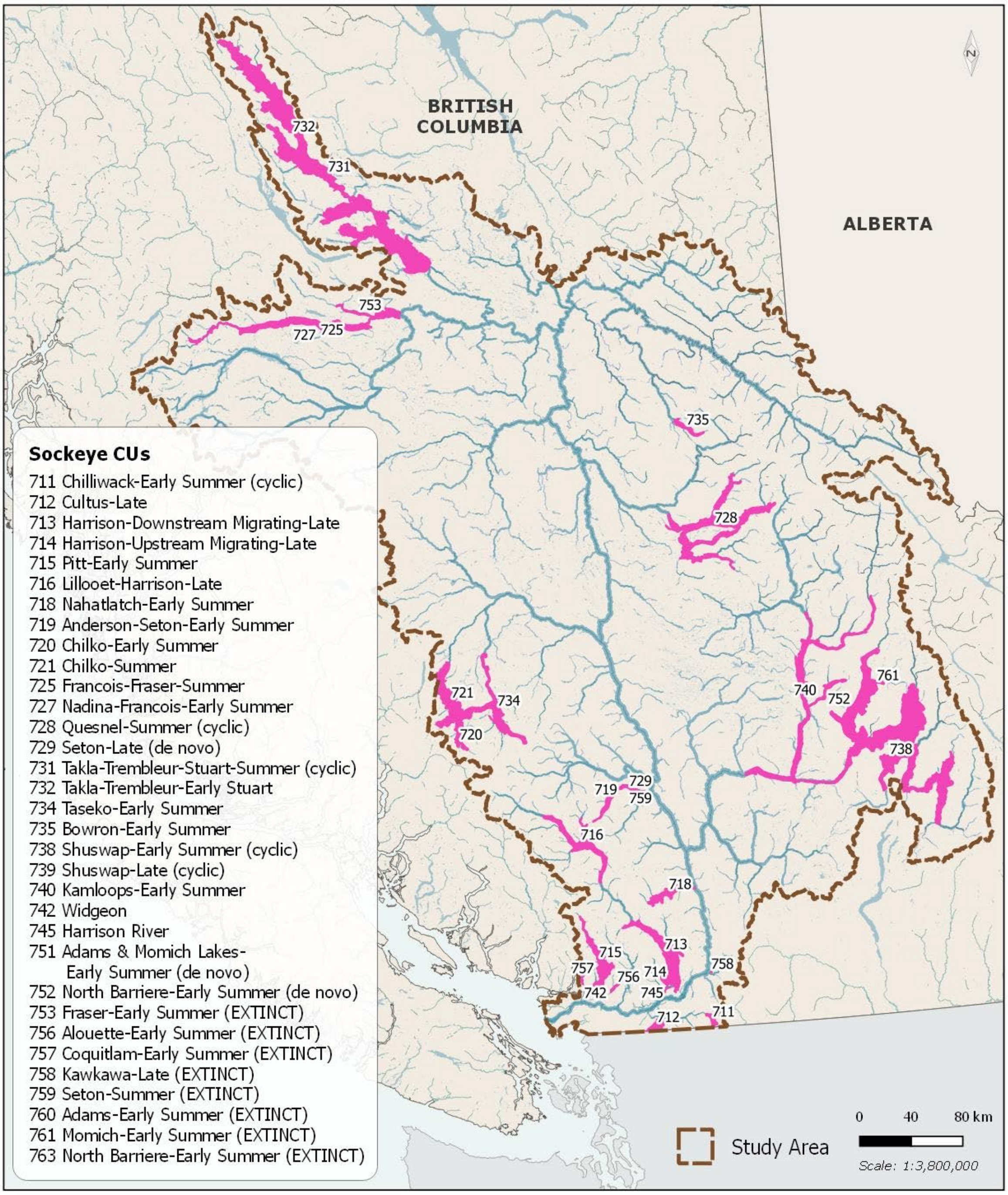

Figure A.23. Sockeye salmon CUs in the Fraser Region.

Pink

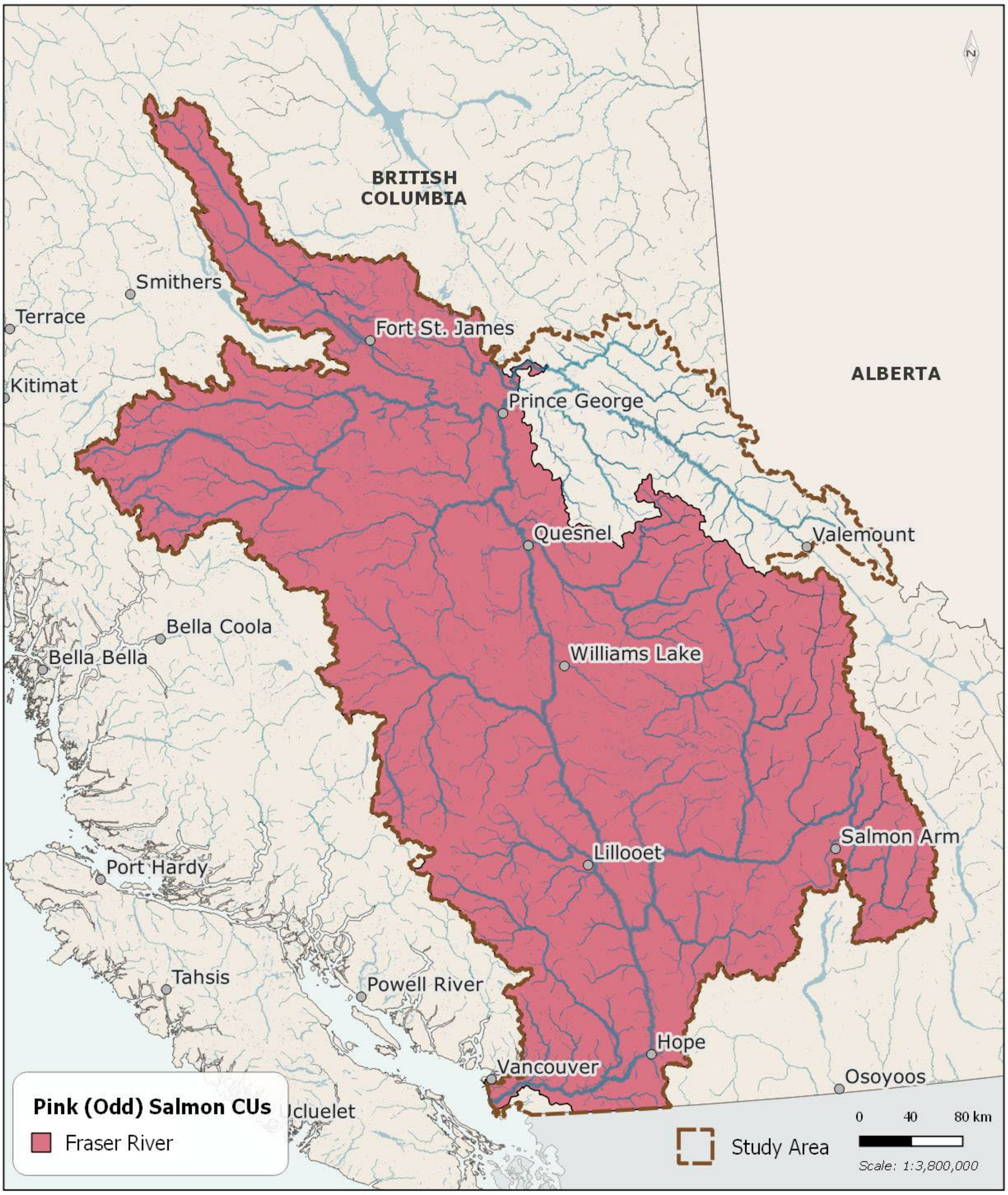

Figure A.24. Pink (odd) salmon CUs in the Fraser Region.

Chinook

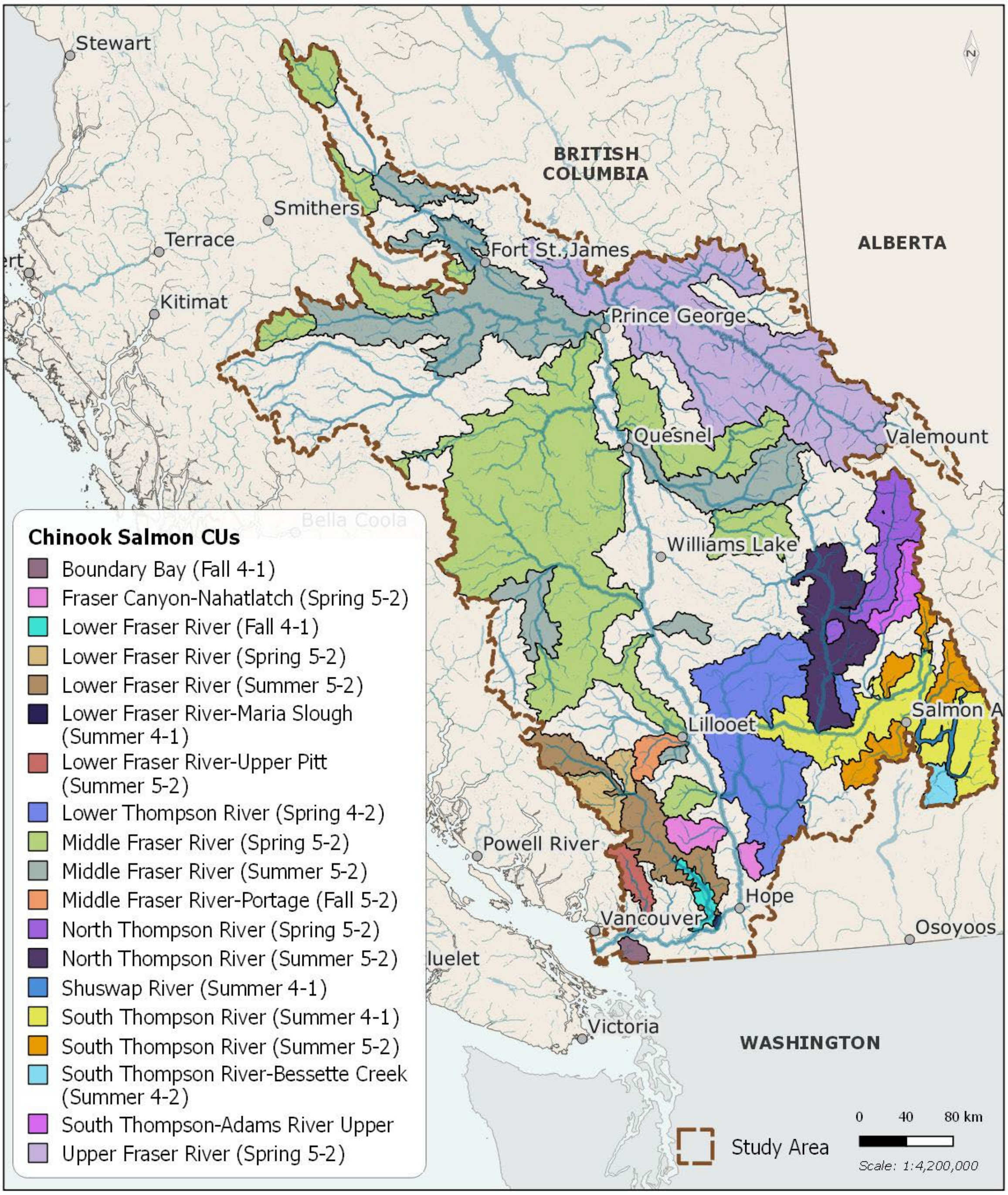

Figure A.25. Chinook salmon CUs in the Fraser Region.

Chum

Figure A.26. Chum salmon CUs in the Fraser Region.

Coho

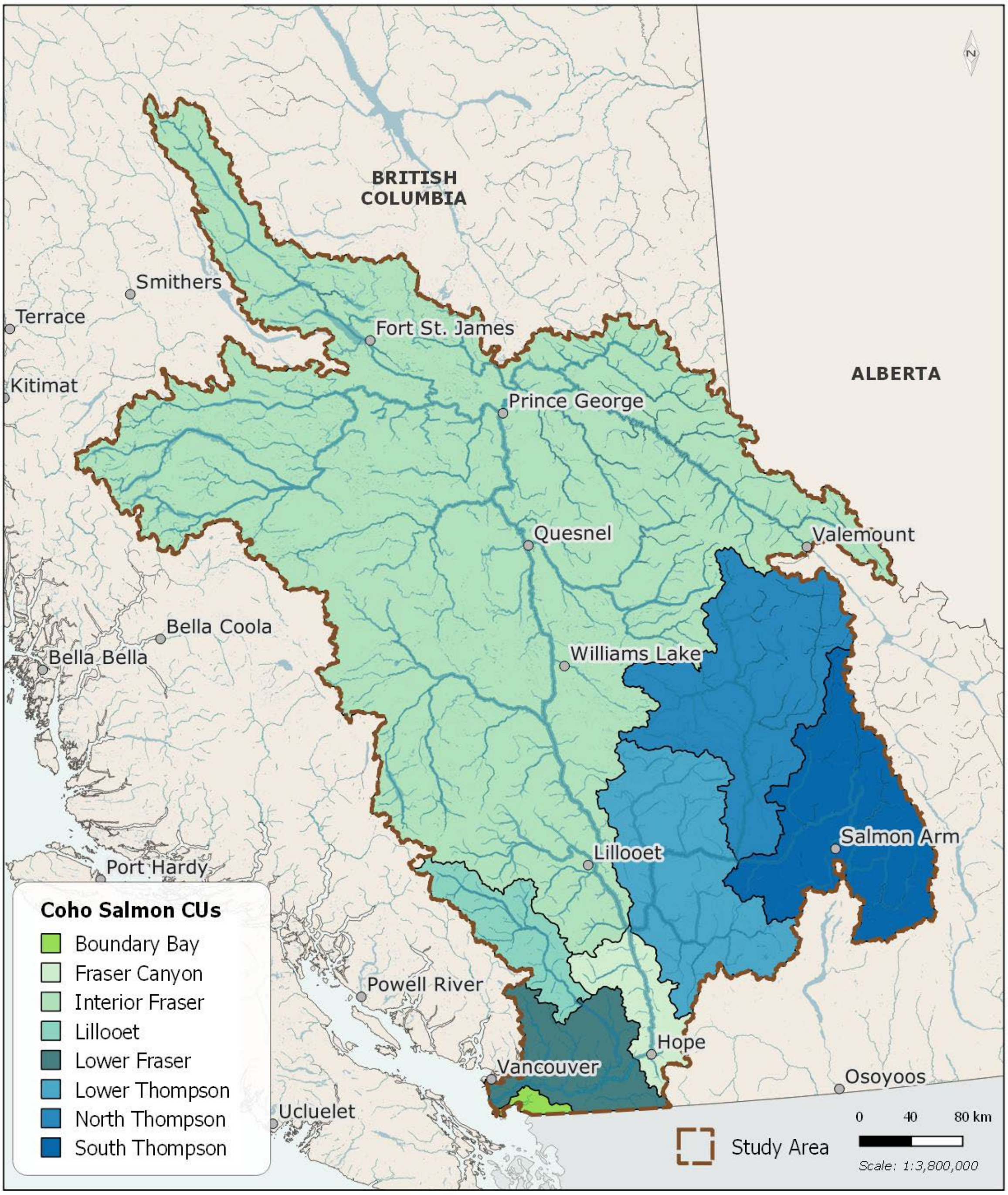

Figure A.27. Coho salmon CUs in the Fraser Region.

Vancouver Island & Mainland Inlets Region

Sockeye

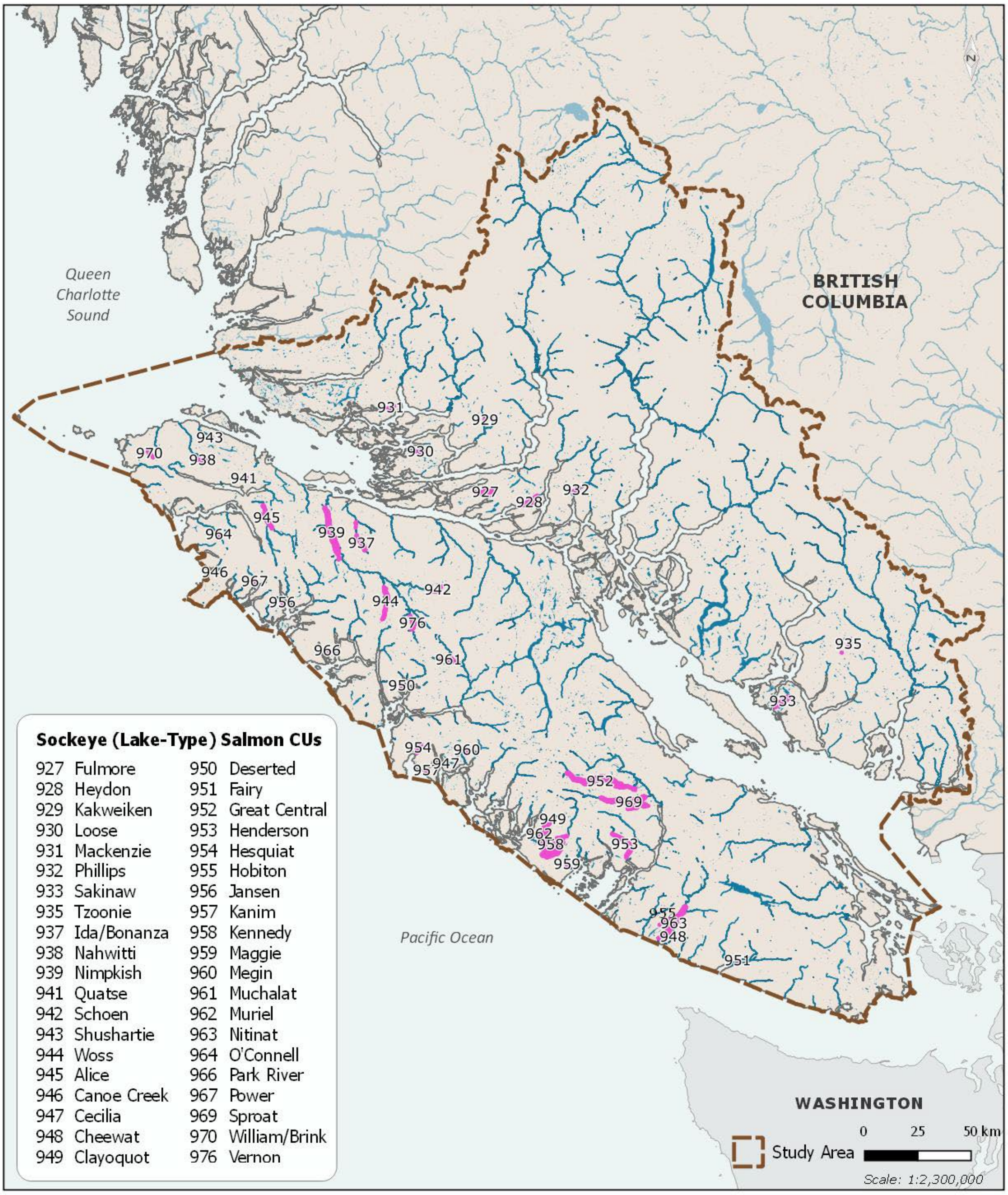

Figure A.28. Sockeye (lake-type) salmon CUs in the VIMI Region.

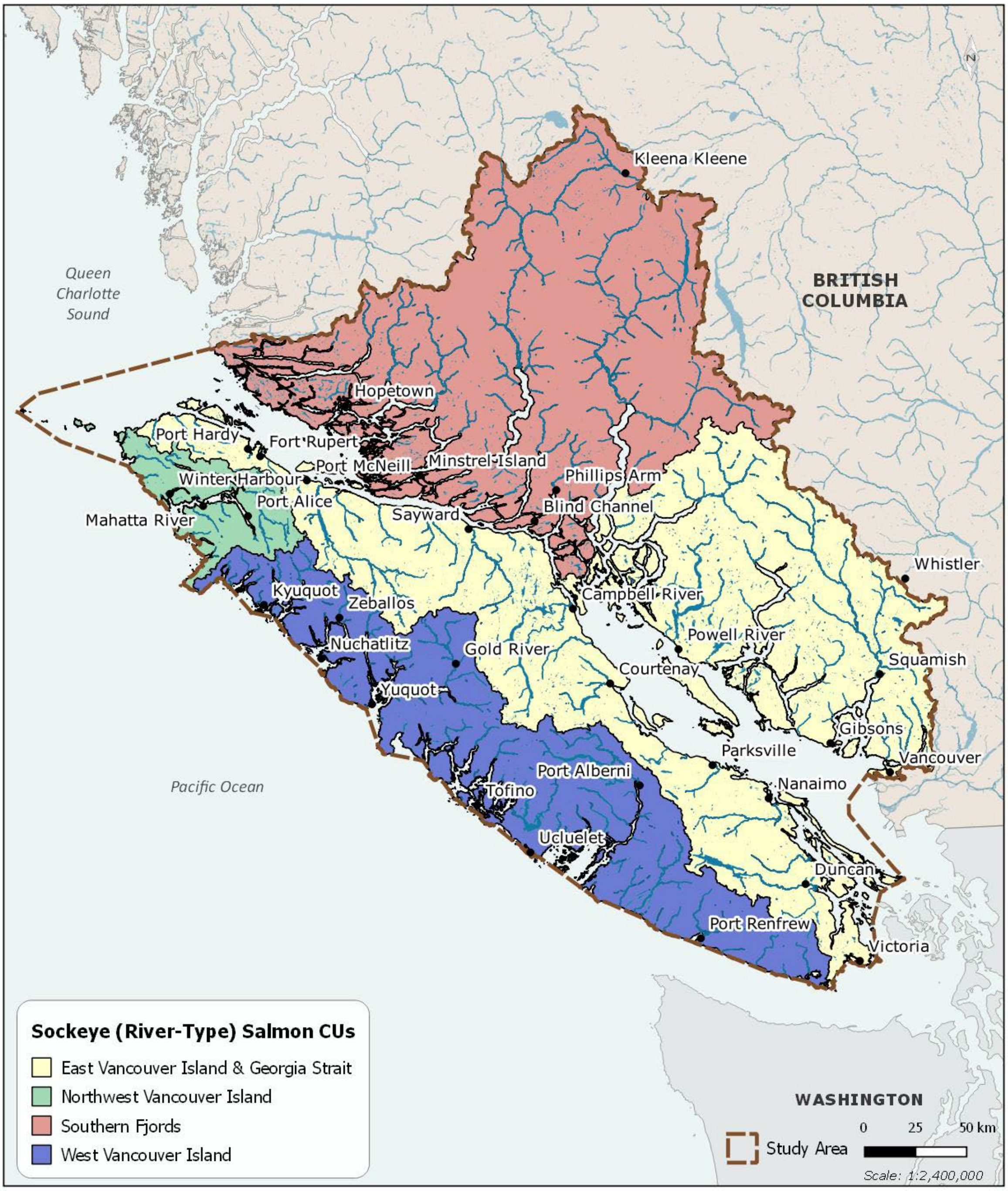

Figure A.29. Sockeye (river-type) salmon CUs in the VIMI Region.

Pink

Figure A.30. Pink (odd) salmon CUs in the VIMI Region.

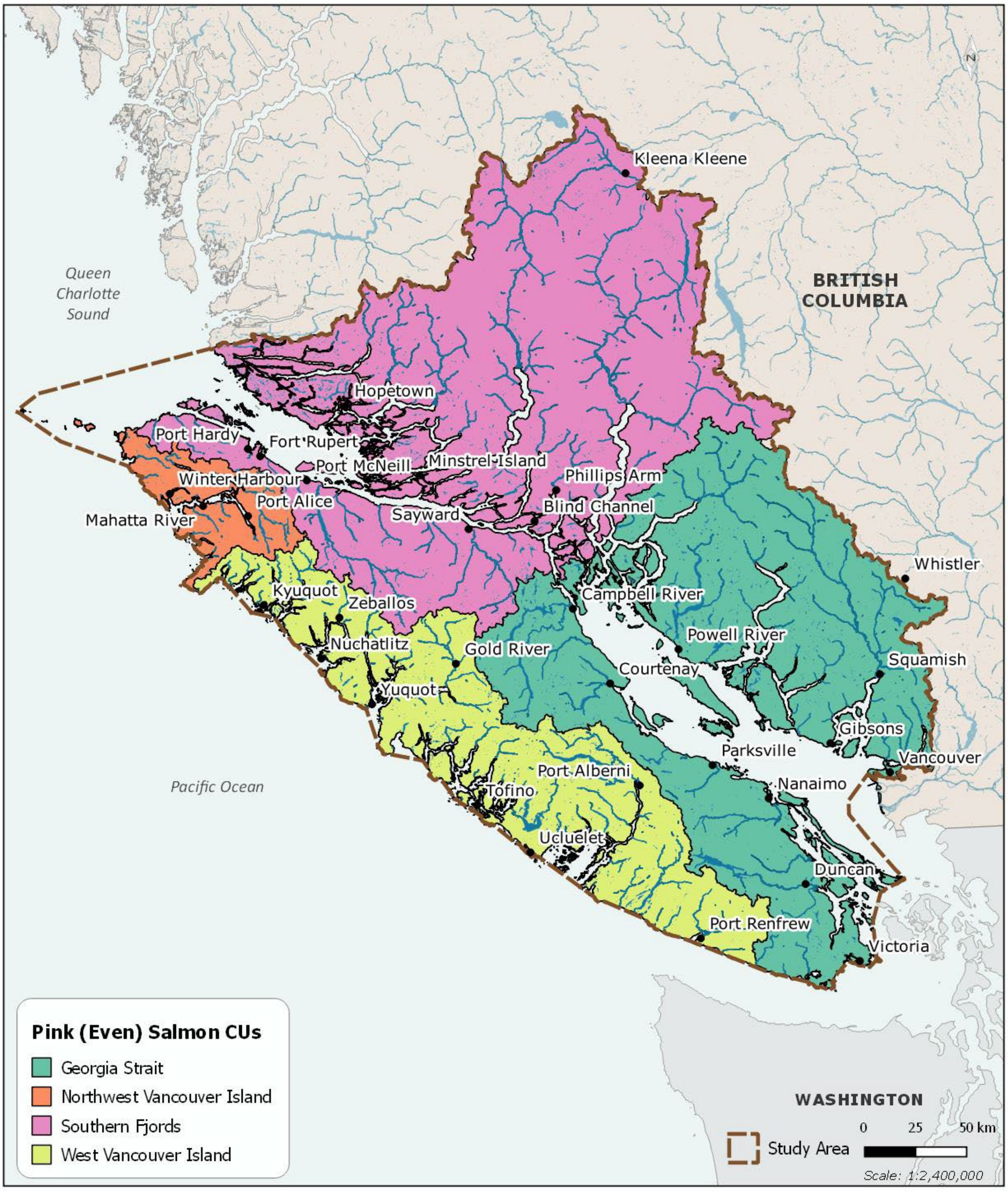

Figure A.31. Pink (even) salmon CUs in the VIMI Region.

Chinook

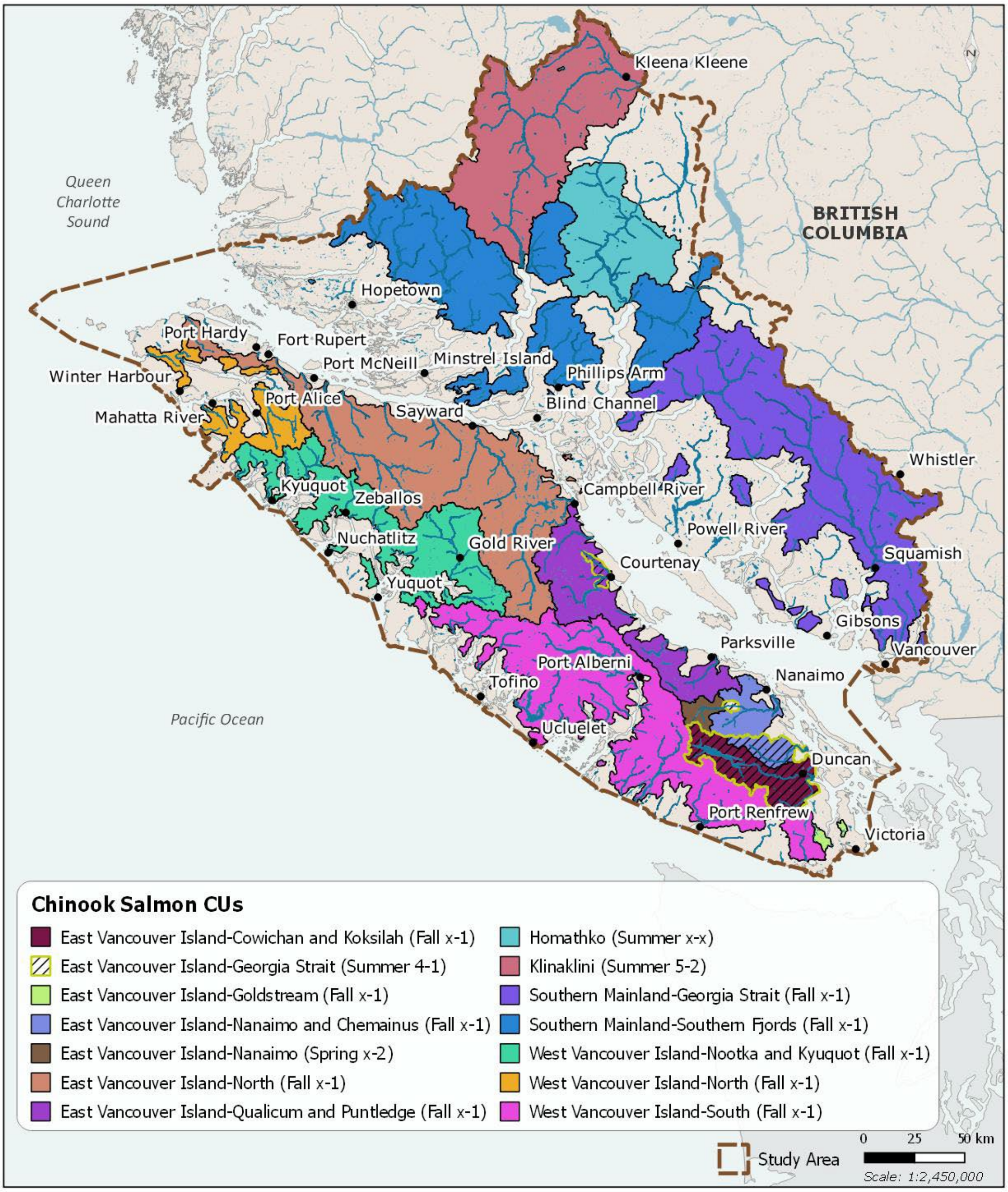

Figure A.32. Chinook salmon CUs in the VIMI Region.

Chum

Figure A.33. Chum salmon CUs in the VIMI Region.

Coho

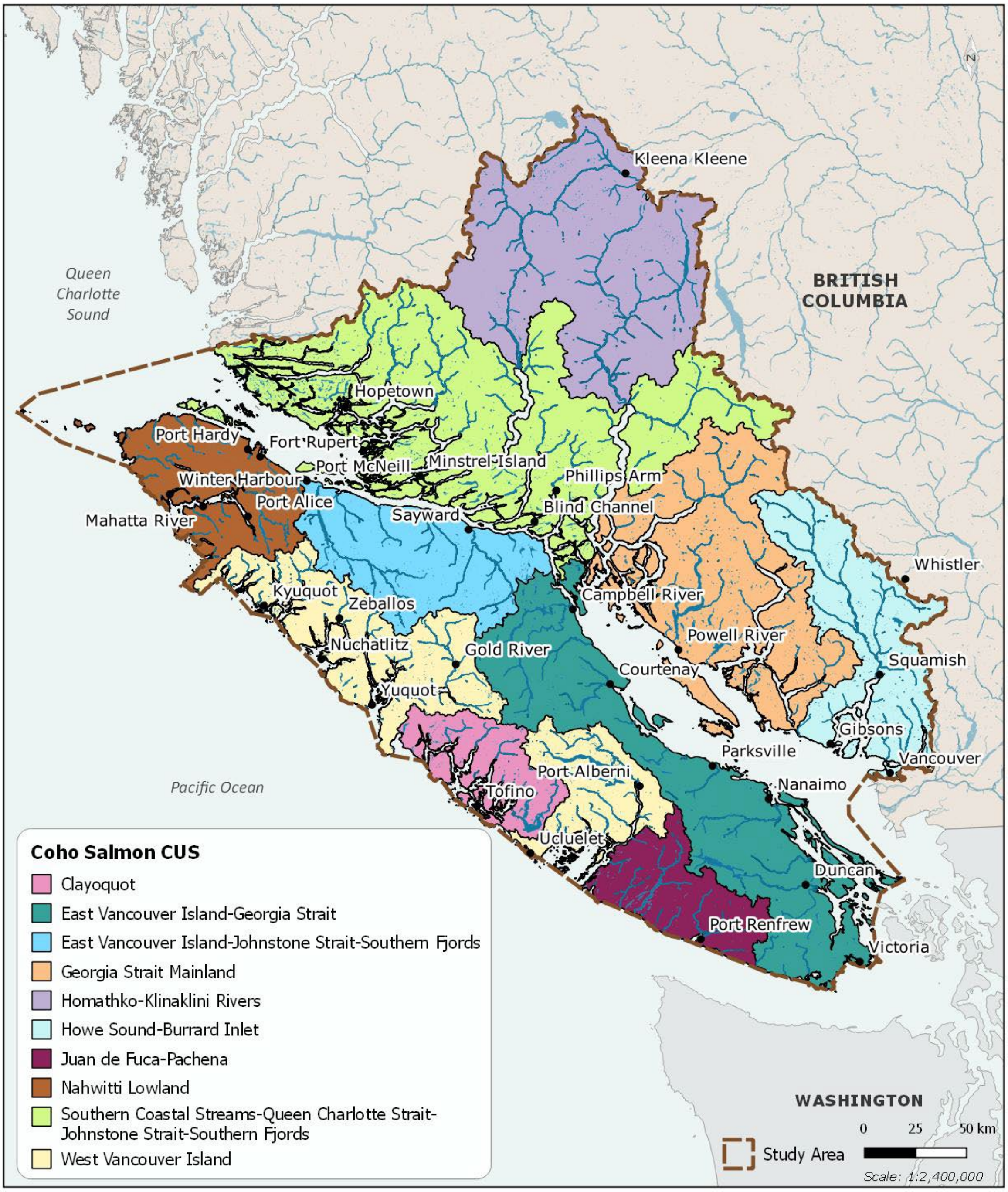

Figure A.34. Coho salmon CUs in the VIMI Region.

Haida Gwaii Region

Sockeye

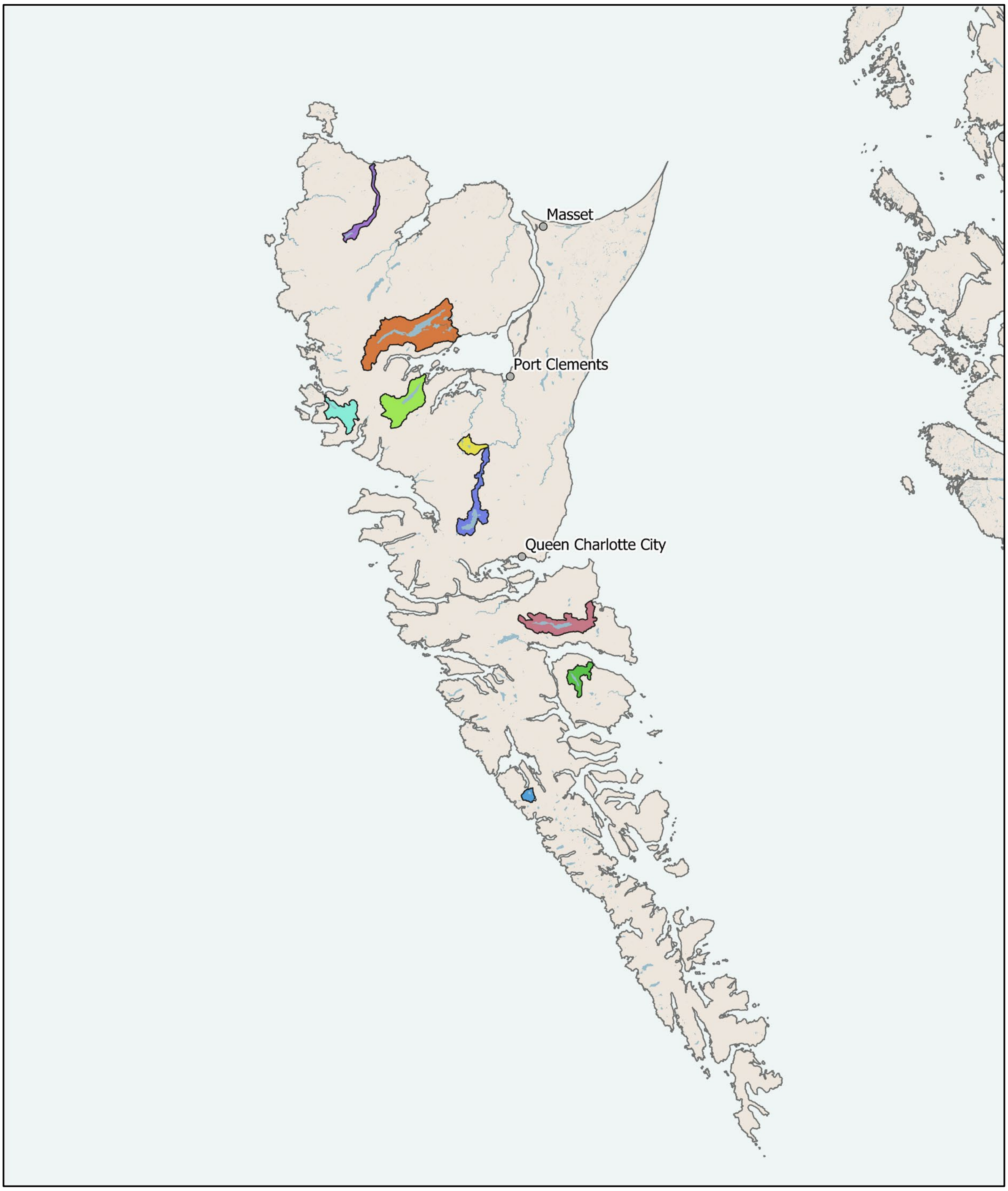

Figure A.35. Sockeye (lake-type) salmon CUs in the Haida Gwaii Region.

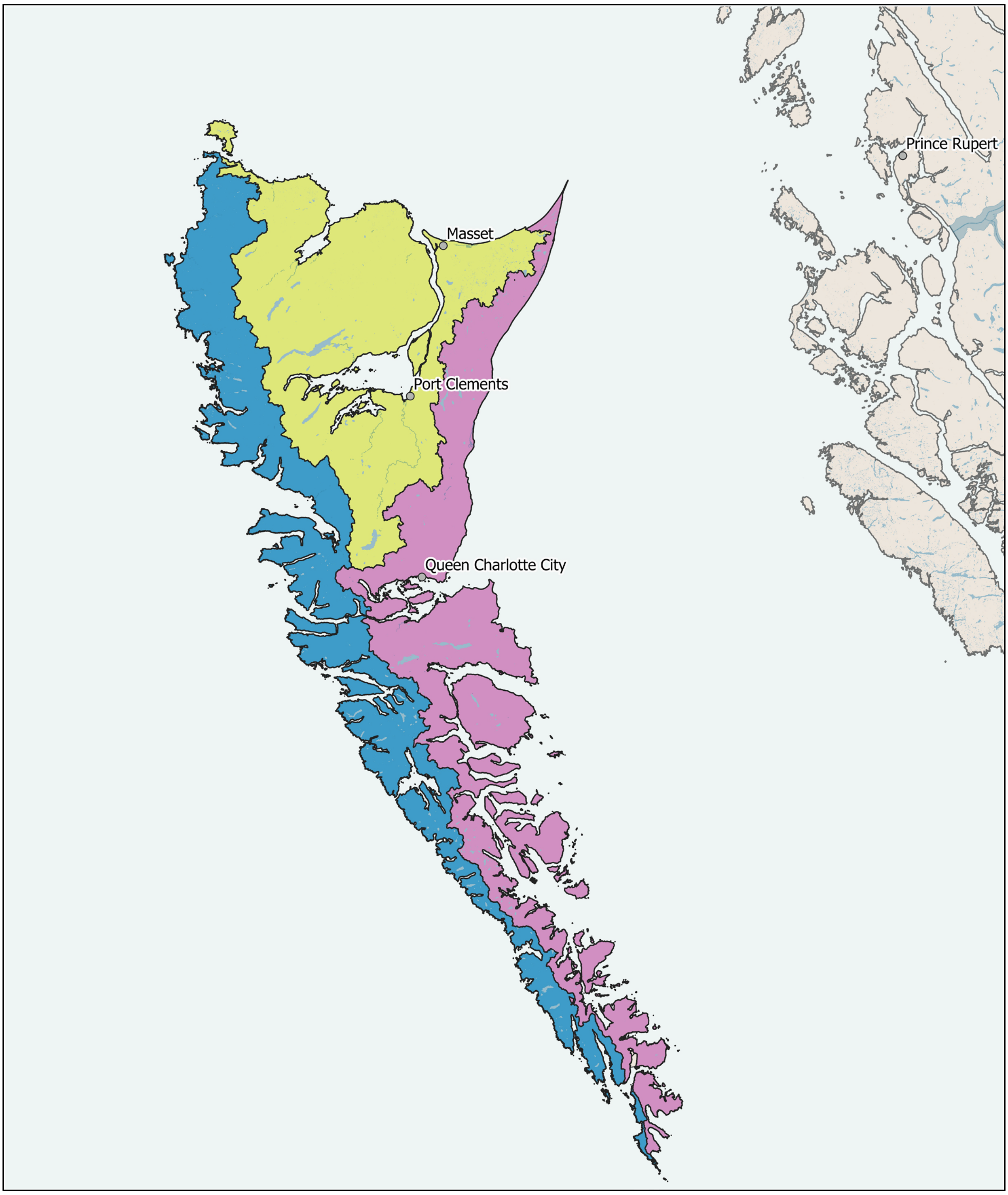

Figure A.36. Sockeye (river-type) salmon CUs in the Haida Gwaii Region.

Pink

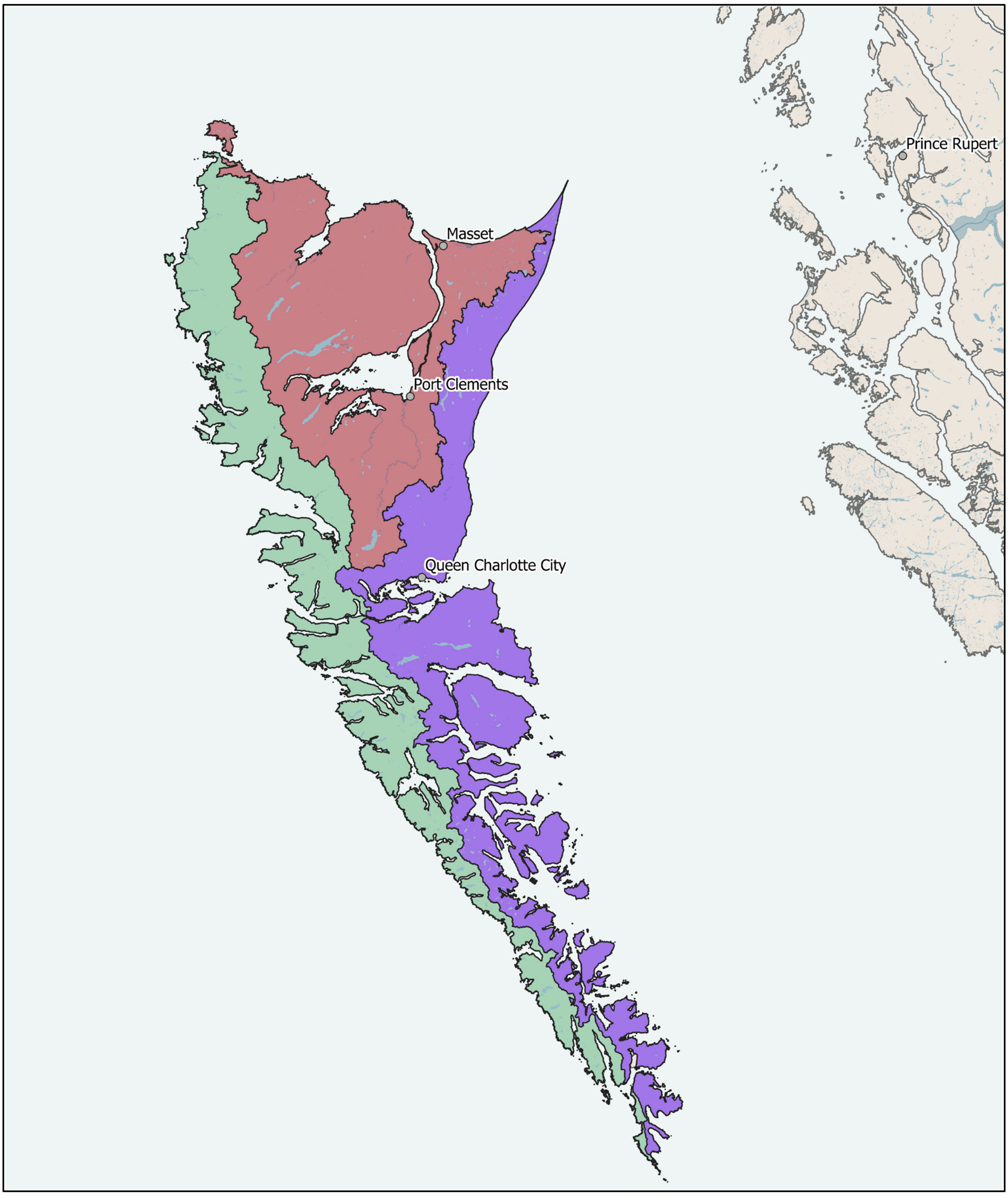

Figure A.37. Pink (odd) salmon CUs in the Haida Gwaii Region.

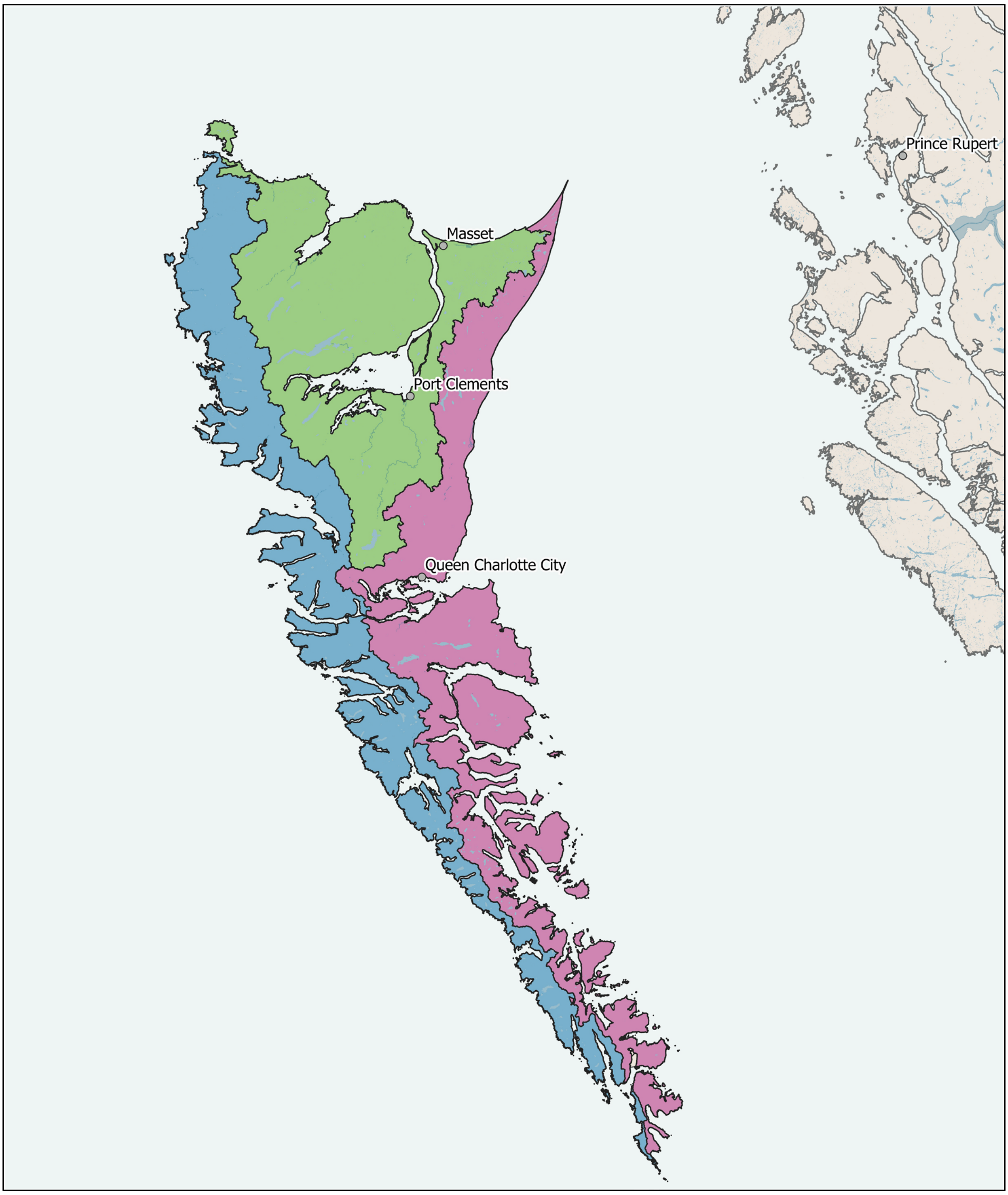

Figure A.38. Pink (even) salmon CUs in the Haida Gwaii Region.

Chinook

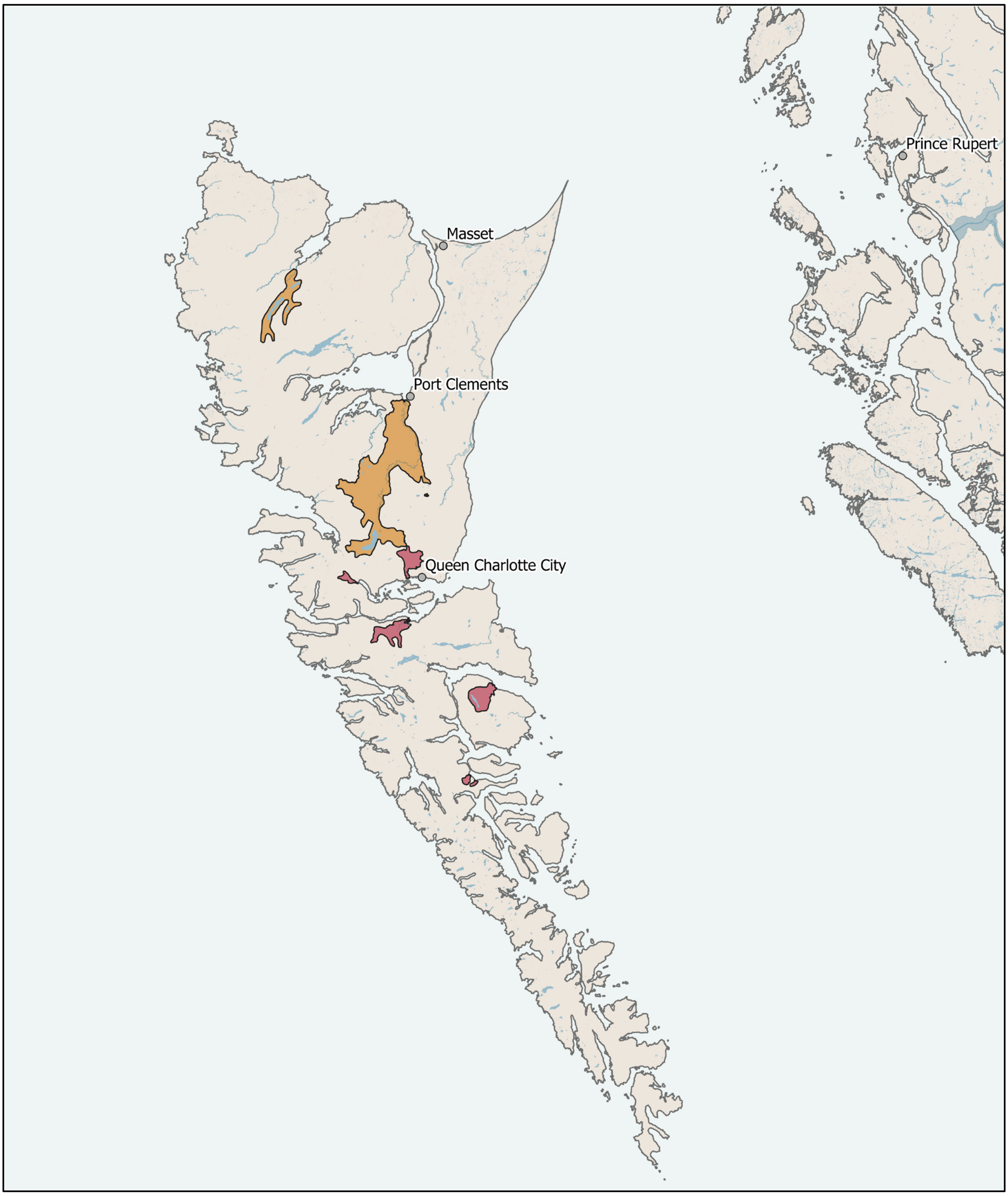

Figure A.39. Chinook salmon CUs in the Haida Gwaii Region.

Chum

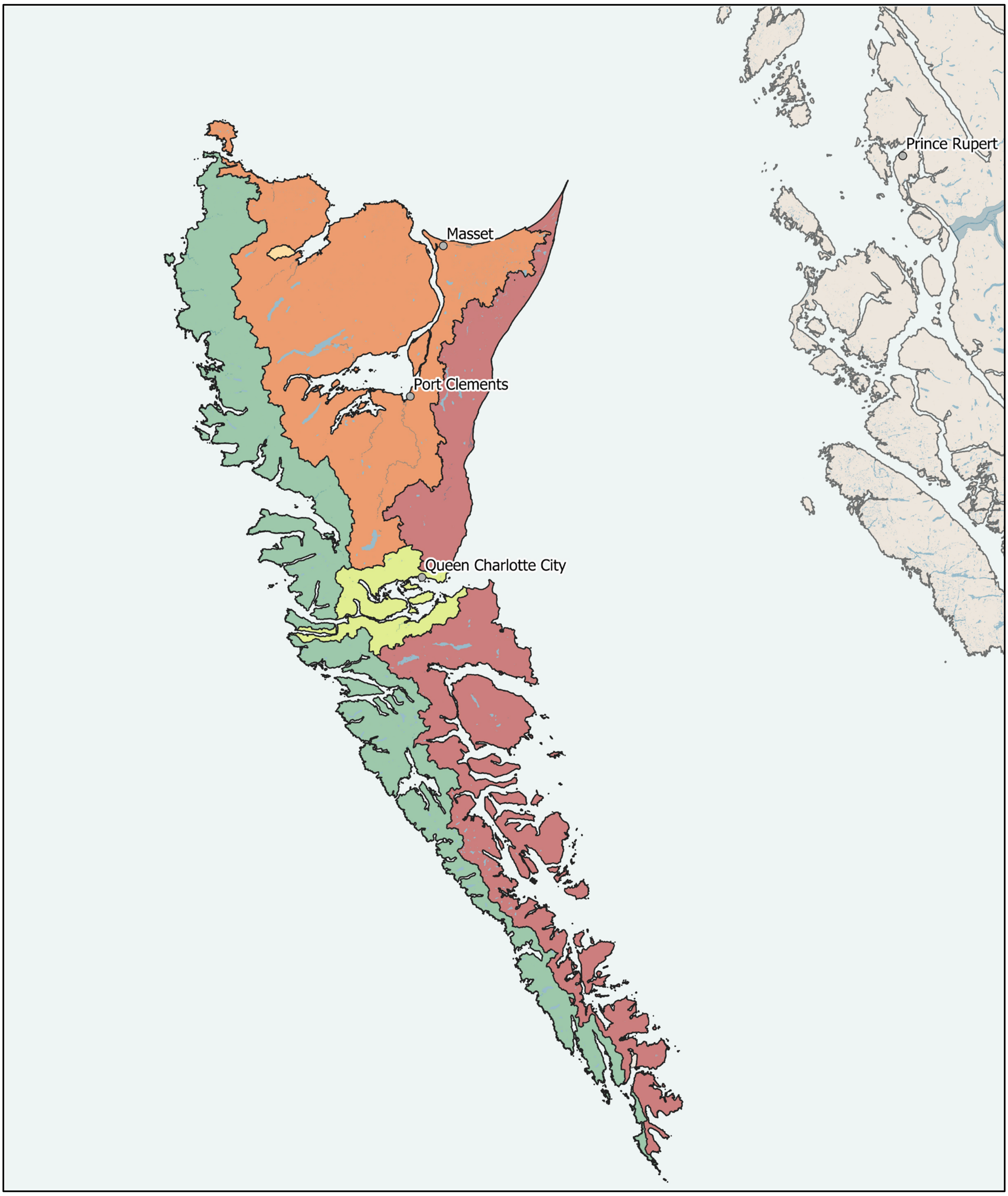

Figure A.40. Chum salmon CUs in the Haida Gwaii Region.

Coho

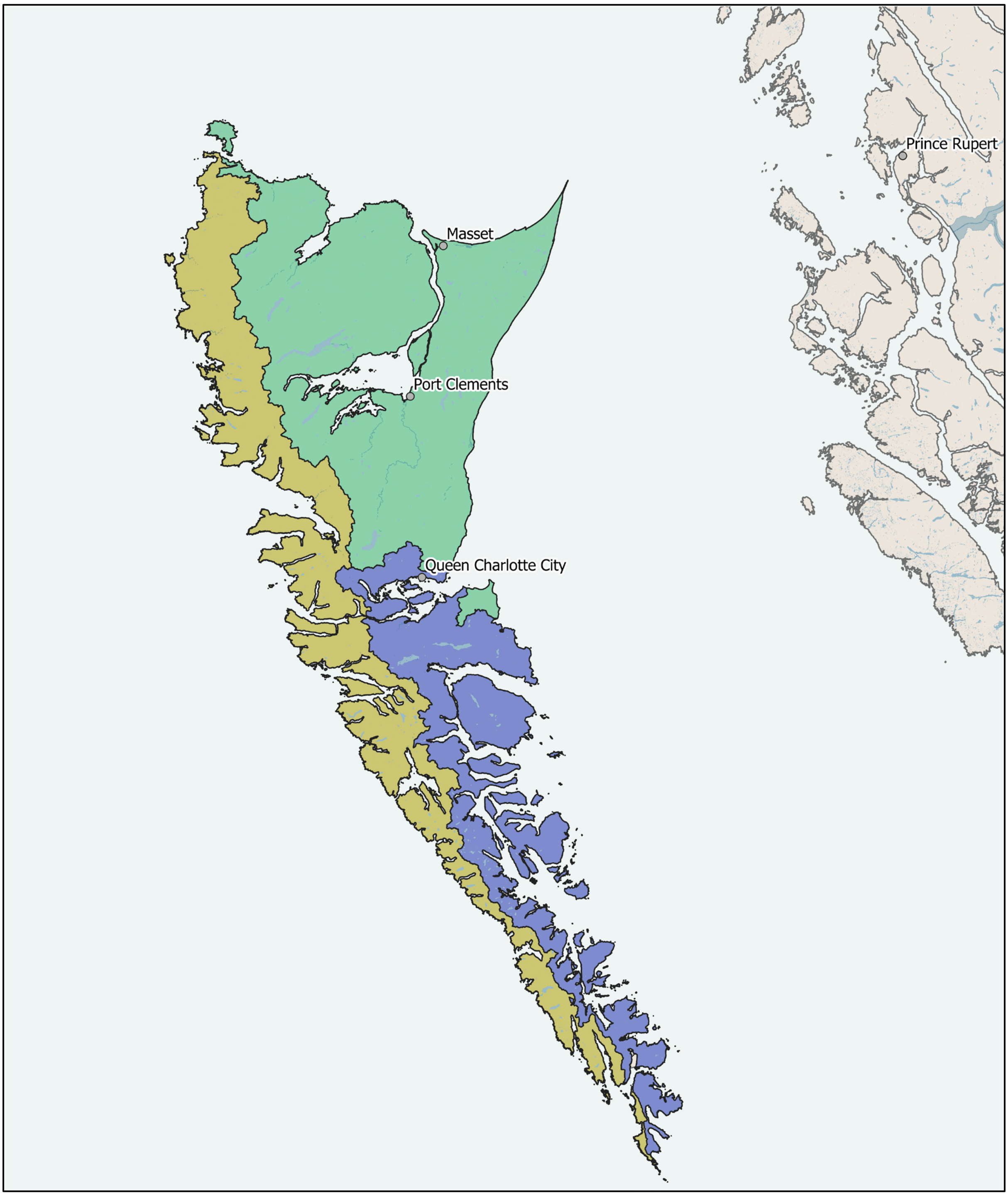

Figure A.41. Coho salmon CUs in the Haida Gwaii Region.

Columbia Region

Sockeye

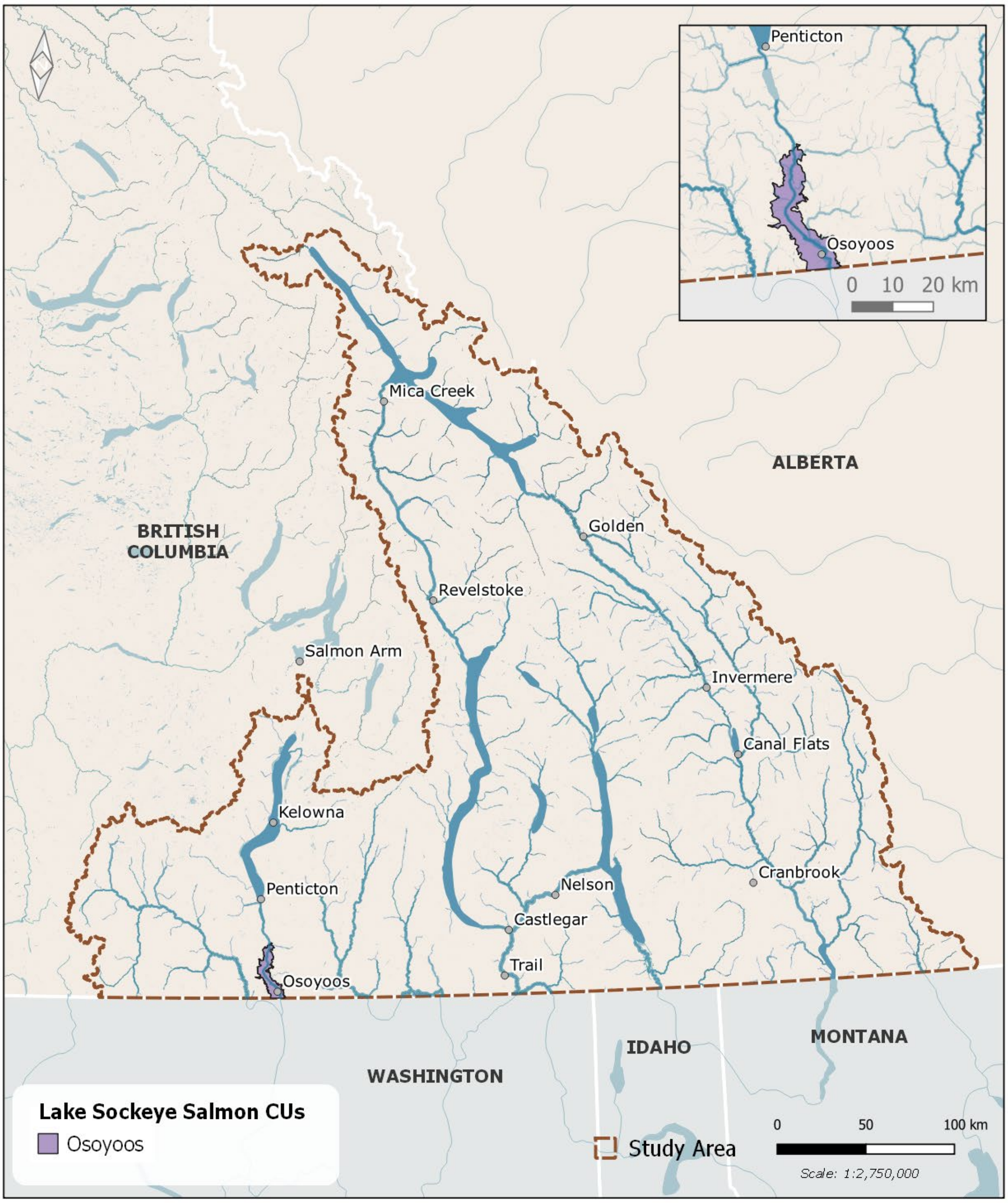

Figure A.42. Sockeye (lake-type) salmon CU in the Columbia Region.

Chinook

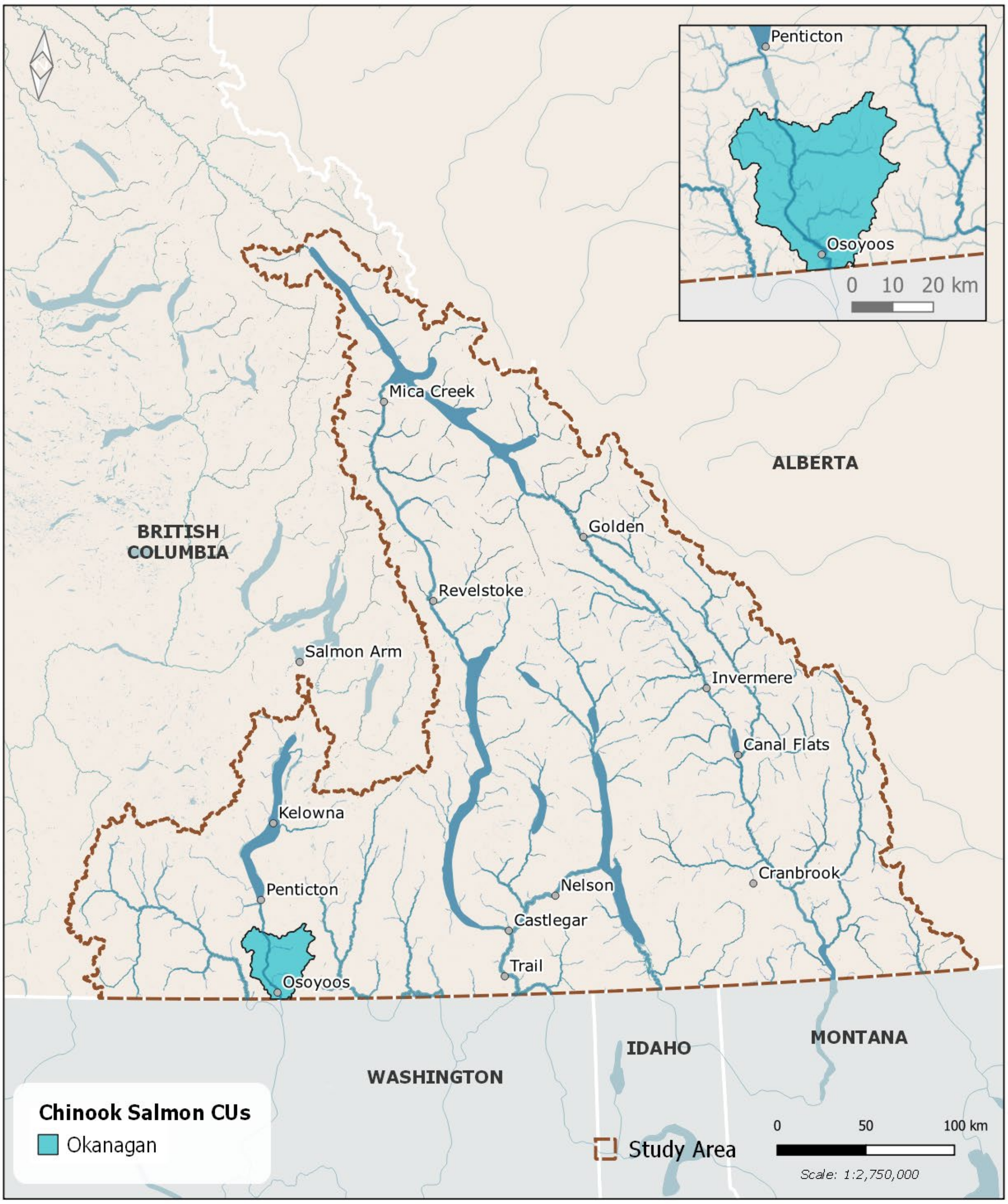

Figure A.43. Chinook salmon CU in the Columbia Region.

Appendix 3: Map of all the FWA watersheds in BC

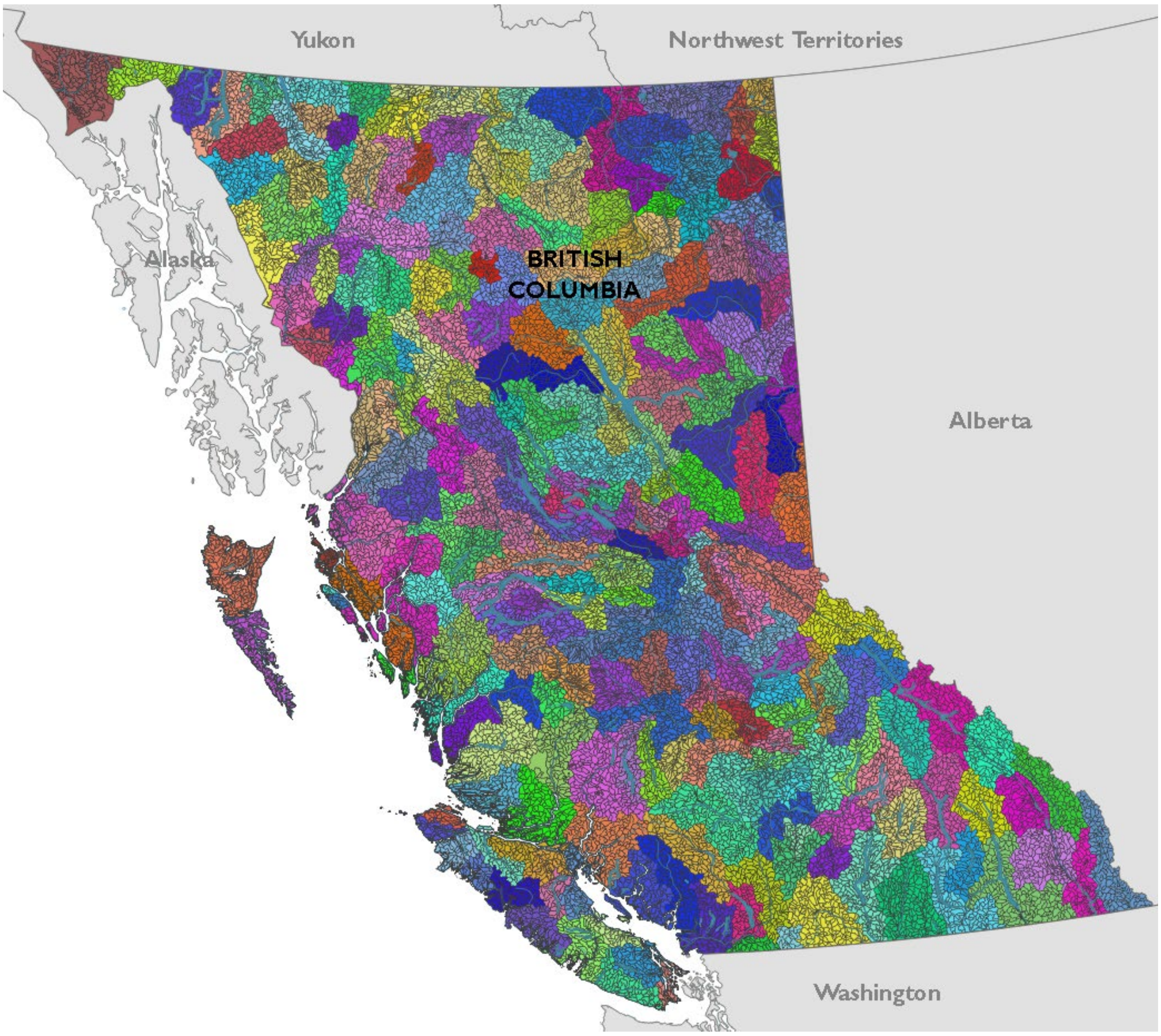

Figure A.44. All Freshwater Atlas (FWA) Assessment Watersheds in BC(n=19469). FWA Assessment Watershed are those adjoining features outlined in black. FWA assessment watersheds are defined at a 1:20,000 watershed scale and delineated with sizes between 2,000 to 10,000 hectares by the Province of BC and are the basis for the freshwater habitat status assessments described in this report. The larger colorings show the 246 FWA watershed groups in BC.

Appendix 4: Biological Status Details

Skeena Region

Table A. 8. Is the summary statistics, biological status assessments, and benchmarks values for Skeena Region Conservation Units (CUs).

Current abundance is expressed as the average over the most recent generation, shown in parentheses. Years of Data shows the number of years over the time series with CU-level estimates of spawner abundance. For the spawner-recruitment metric, the percentage in each column is the probability (%) of a given status based on the benchmarks (SGEN and 80% SMSY) estimated from a Hierarchical Bayesian Model. For the spawner-recruitment benchmark values, 95% credible intervals are shown in parentheses. The percentile benchmark values show 95% confidence intervals in parentheses. The Pacific Salmon Foundation benchmark method and status shown on the Pacific Salmon Explorer for each CU are noted by the highlighted status color.

Conservation Unit	Current Abundance	Years of Data	# of spawner-recruitment pairs	Biological Status						Status Metrics			
				Percentile	Spawner-Recruitment			WSP	COSEWIC	Percentile		Spawner-Recruitment	
					% Chance of Red Status	% Chance of Amber Status	% Chance of Green Status			Lower Benchmark: 25th percentile (95% CI)	Upper Benchmark: 50th percentile (95% CI)	Lower Benchmark S_{GEN} (95% CI)	Upper Benchmark 80% S_{MSY} (95% CI)
Chinook													
Ecstall	NA	16	TBA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Conservation Unit	Current Abundance	Years of Data	# of spawner-recruitment pairs	Biological Status						Status Metrics			
				Percentile	Spawner-Recruitment			WSP	COSEWIC	Percentile		Spawner-Recruitment	
					% Chance of Red Status	% Chance of Amber Status	% Chance of Green Status			Lower Benchmark : 25th percentile (95% CI)	Upper Benchmark : 50th percentile (95% CI)	Lower Benchmark S_{GEN} (95% CI)	Upper Benchmark 80% S_{MSY} (95% CI)
Kalum-Early	NA	31	TBA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Kalum-Late	8125	36	TBA		3%	24%	73%	NA	NA	9892	12527	8125 (2522-997)	7145 (5390-13944)
Lakelse	NA	NA	TBA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Lower Skeena	512	33	TBA		29%	71%	0%	NA	NA	892	1416	512 (389-173)	953 (698-2706)
Middle Skeena-Large Lakes	20,788	38	TBA		0%	7%	93%	NA	NA	19371	28669	4296 (2145-14834)	16067 (12800-23828)
Middle Skeena-Mainstem	5129	37	TBA		0%	45%	55%	NA	NA	5465	8281	1090 (578-	5056 (4141-

Conservation Unit	Current Abundance	Years of Data	# of spawner-recruitment pairs	Biological Status						Status Metrics			
				Percentile	Spawner-Recruitment			WSP	COSEWIC	Percentile		Spawner-Recruitment	
					% Chance of Red Status	% Chance of Amber Status	% Chance of Green Status			Lower Benchmark: 25th percentile (95% CI)	Upper Benchmark: 50th percentile (95% CI)	Lower Benchmark S_{GEN} (95% CI)	Upper Benchmark 80% S_{MSY} (95% CI)
Tributaries												2333)	6918)
Sicintine	NA	NA	TBA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Skeena Estuary	NA	NA	TBA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Upper Bulkley River	NA	26	TBA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Upper Skeena	NA	NA	TBA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Zymoetz	NA	NA	TBA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chum													
Lower	1824	61	TBA		100%	0%	0%	NA	NA	6265	10271	9209	14530

Conservation Unit	Current Abundance	Years of Data	# of spawner-recruitment pairs	Biological Status						Status Metrics			
				Percentile	Spawner-Recruitment			WSP	COSEWIC	Percentile		Spawner-Recruitment	
					% Chance of Red Status	% Chance of Amber Status	% Chance of Green Status			Lower Benchmark : 25th percentile (95% CI)	Upper Benchmark : 50th percentile (95% CI)	Lower Benchmark S_{GEN} (95% CI)	Upper Benchmark 80% S_{MSY} (95% CI)
Skeena												(6026-14489)	(9925-22979)
Middle Skeena	NA	57	TBA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Skeena Estuary	NA	40	TBA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Upper Skeena	NA	NA	TBA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Coho													
Lower Skeena	78064	63	TBA		0%	0%	100%	NA	NA	63168	115767	38624 (35010-41359)	61798 (560156-66175)
Middle Skeena	188744	64	TBA		0%	0%	100%	NA	NA	50514	74298	34089 (31266-36450)	54542 50027-

Conservation Unit	Current Abundance	Years of Data	# of spawner-recruitment pairs	Biological Status						Status Metrics			
				Percentile	Spawner-Recruitment			WSP	COSEWIC	Percentile		Spawner-Recruitment	
					% Chance of Red Status	% Chance of Amber Status	% Chance of Green Status			Lower Benchmark : 25th percentile (95% CI)	Upper Benchmark : 50th percentile (95% CI)	Lower Benchmark S_{GEN} (95% CI)	Upper Benchmark 80% S_{MSY} (95% CI)
													58320)
Skeena Estuary	NA	52	TBA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Upper Skeena	15300	34	TBA		0%	2%	98%	NA	NA	5848	8578	2467 (1084-9456)	6631 (4835-15084)
Pink (odd-year)													
Lower-Skeena River (odd)	176055	32	TBA		89%	11%	0%	NA	NA	567705	995218	607187 (0-2530608552206)	1105724 (635373-4.68E+12)
Middle-Upper Skeena River (odd)	853053	32	TBA		21%	39%	39%	NA	NA	558574	790940	533829 (0-	958422 (563841-

Conservation Unit	Current Abundance	Years of Data	# of spawner-recruitment pairs	Biological Status						Status Metrics			
				Percentile	Spawner-Recruitment			WSP	COSEWIC	Percentile		Spawner-Recruitment	
					% Chance of Red Status	% Chance of Amber Status	% Chance of Green Status			Lower Benchmark: 25th percentile (95% CI)	Upper Benchmark: 50th percentile (95% CI)	Lower Benchmark S_{GEN} (95% CI)	Upper Benchmark 80% S_{MSY} (95% CI)
												64577135)	1.46+12)
Nass-Skeena Estuary (odd)	104406	32	TBA		60%	39%	1%	NA	NA	86792	114406	112060 (69404-270554)	179297 (111046-432886)
Pink (even-year)													
Middle-Upper Skeena (even)	160195	32	TBA		77%	23%	0%	NA	NA	158829	252855	245629 (0-118995817 78696	604148 (230204-1.98E+13)
Nass-Skeena Estuary (even)	824510	32	TBA		6%	34%	61%	NA	NA	724447	1120264	484351 (346435-1322361)	780730 (584019-13906355)
			TBA										

Conservation Unit	Current Abundance	Years of Data	# of spawner-recruitment pairs	Biological Status						Status Metrics			
				Percentile	Spawner-Recruitment			WSP	COSEWIC	Percentile		Spawner-Recruitment	
					% Chance of Red Status	% Chance of Amber Status	% Chance of Green Status			Lower Benchmark: 25th percentile (95% CI)	Upper Benchmark: 50th percentile (95% CI)	Lower Benchmark S_{GEN} (95% CI)	Upper Benchmark 80% S_{MSY} (95% CI)
Sockeye (lake-type)													
Alastair	15423	57	TBA		0%	0%	100%	NA	NA	6953	14580	2580 (1607 - 4531)	7119 (6062-8895)
Asitika	1314	29	TBA		0%	0%	100%	NA	NA	250	600	61 (20-142)	335 (17965-498)
Azuklotz	3321	42	TBA		0%	1%	99%	NA	NA	1184	2450	889 (476-1572)	1937 (1357-3000)
Babine (enhanced)	544456	58	TBA		1%	3%	96%	NA	NA	211645	381743	180836 (126905-374851)	289337 (203047-599762)

Conservation Unit	Current Abundance	Years of Data	# of spawner-recruitment pairs	Biological Status						Status Metrics			
				Percentile	Spawner-Recruitment			WSP	COSEWIC	Percentile		Spawner-Recruitment	
					% Chance of Red Status	% Chance of Amber Status	% Chance of Green Status			Lower Benchmark : 25th percentile (95% CI)	Upper Benchmark : 50th percentile (95% CI)	Lower Benchmark S_{GEN} (95% CI)	Upper Benchmark 80% S_{MSY} (95% CI)
Babine/Onerka	25531	58	TBA		12%	84%	4%	NA	NA	28194	42808	19975 (14445-34205)	31960 (24768-54727)
Bear	5196	39	TBA		81%	16%	3%	NA	NA	642	1781	7004 (3627-14122)	11130 (5118-22670)
Bulkley/Maxan	NA	NA	TBA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Damshilgwit	342	18	TBA		33%	41%	26%	NA	NA	274	382	297 (160-559)	426 (227-874)
Ecstall/Lower	NA	NA	TBA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Footsore/Hodder	NA	NA	TBA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Conservation Unit	Current Abundance	Years of Data	# of spawner-recruitment pairs	Biological Status						Status Metrics			
				Percentile	Spawner-Recruitment			WSP	COSEWIC	Percentile		Spawner-Recruitment	
					% Chance of Red Status	% Chance of Amber Status	% Chance of Green Status			Lower Benchmark : 25th percentile (95% CI)	Upper Benchmark : 50th percentile (95% CI)	Lower Benchmark S_{GEN} (95% CI)	Upper Benchmark 80% S_{MSY} (95% CI)
Gitanyow (Kitwanga/ Kitwancool)	1832	30	TBA		100%	0%	0%	NA	NA	400	883	6738 (3449-14641)	11772 (5507-23933)
Johanson	NA	NA	TBA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Johnston	NA	29	TBA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Kitsumkalum	27202	56	TBA		0%	0%	100%	NA	NA	2311	6981	4319 (2843-7986)	9601 (73689-7368)
Kluatantan	NA	NA	TBA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Kluayaz	NA	NA	TBA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Lakelse	13094	54	TBA		0%	0%	100%	NA	NA	5999	11365	4783 (3318-	7713 (5914-

Conservation Unit	Current Abundance	Years of Data	# of spawner-recruitment pairs	Biological Status						Status Metrics			
				Percentile	Spawner-Recruitment			WSP	COSEWIC	Percentile		Spawner-Recruitment	
					% Chance of Red Status	% Chance of Amber Status	% Chance of Green Status			Lower Benchmark: 25th percentile (95% CI)	Upper Benchmark: 50th percentile (95% CI)	Lower Benchmark S_{GEN} (95% CI)	Upper Benchmark 80% S_{MSY} (95% CI)
												6728)	10457)
Mcdonell/ Dennis/Aldrich	5703	47	TBA		0%	0%	100%	NA	NA	1500	3400	637 (394-1018)	1690 (1396-2140)
Morice/Atna	13981	55	TBA		100%	0%	0%	NA	NA	3778	7196	34548 (17499-67094)	55276 (27944-107350)
Motase	1124	28	TBA		0%	0%	100%	NA	NA	180	400	247 (138- 458)	409 (241-772)
Nilkitkwa	100721	58	TBA		71%	29%	0%	NA	NA	121358	166077	116622 (76230-276879)	186596 (121969-443007)

Conservation Unit	Current Abundance	Years of Data	# of spawner-recruitment pairs	Biological Status						Status Metrics			
				Percentile	Spawner-Recruitment			WSP	COSEWIC	Percentile		Spawner-Recruitment	
					% Chance of Red Status	% Chance of Amber Status	% Chance of Green Status			Lower Benchmark : 25th percentile (95% CI)	Upper Benchmark : 50th percentile (95% CI)	Lower Benchmark S_{GEN} (95% CI)	Upper Benchmark 80% S_{MSY} (95% CI)
Sicintine	NA	NA	TBA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Slamgeesh	NA	NA	TBA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Spawning	NA	NA	TBA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Stephens	7184	54	TBA		0%	0%	100%	NA	NA	5243	7809	697 (320-1470)	3363 (2739-4415)
Sustut	NA	NA	TBA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Swan/Club	3418	47	TBA		99%	1%	0%	NA	NA	4937	9893	5784 (3681-8677)	9438 (6178-13979)
Tahlo/Morrison	23170	58	TBA		0%	0%	100%	NA	NA	8393	16686	4761 (2559-	11619 (8884-

Conservation Unit	Current Abundance	Years of Data	# of spawner-recruitment pairs	Biological Status						Status Metrics			
				Percentile	Spawner-Recruitment			WSP	COSEWIC	Percentile		Spawner-Recruitment	
					% Chance of Red Status	% Chance of Amber Status	% Chance of Green Status			Lower Benchmark: 25th percentile (95% CI)	Upper Benchmark: 50th percentile (95% CI)	Lower Benchmark S_{GEN} (95% CI)	Upper Benchmark 80% S_{MSY} (95% CI)
												11163)	17965)
Sockeye (river-type)													
Skeena River	NA	NA	TBA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Skeena River-High Interior	164	14	TBA		NA	NA	NA	NA	NA	52	98	NA	NA

Nass Region

Table A. 9. Shows summary statistics, biological status assessments, and benchmarks values for the Nass Region Conservation Units (CUs).

Under development

Central Coast Region

Table A. 10. Shows summary statistics, biological status assessments, and benchmarks values for Central Coast Conservation Units (CUs).

Current abundance is expressed as the average over the most recent generation, shown in parentheses. Years of Data shows the number of years over the time series with CU-level estimates of spawner abundance. For the spawner-recruitment metric, the percentage in each column is the probability (%) of a given status based on the benchmarks (SGEN and 80% SMSY) estimated from a Hierarchical Bayesian Model. For the spawner-recruitment benchmark values, 95% credible intervals are shown in parentheses. The percentile benchmark values show 95% confidence intervals in parentheses. The Pacific Salmon Foundation benchmark method and status shown on the Pacific Salmon Explorer for each CU are noted by the highlighted status color.

Conservation Unit	Current Abundance	Years of Data	# of spawner-recruitment pairs	Biological Status						Status Metrics			
				Percentile	Spawner-Recruitment			WSP	COSEWIC	Percentile		Spawner-Recruitment	
					% Chance of Red Status	% Chance of Amber Status	% Chance of Green Status			Lower Benchmark: 25th percentile (95% CI)	Upper Benchmark: 50th percentile (95% CI)	Lower Benchmark S_{GEN} (95% CI)	Upper Benchmark 80% S_{MSY} (95% CI)
Chinook													
Bella Coola-Bentinck	22821	33	TBA		0%	0%	100%	NA	NA	14425	20800	3763 (1299-10618)	9045 (6769-16404)

Conservation Unit	Current Abundance	Years of Data	# of spawner-recruitment pairs	Biological Status						Status Metrics			
				Percentile	Spawner-Recruitment			WSP	COSEWIC	Percentile		Spawner-Recruitment	
					% Chance of Red Status	% Chance of Amber Status	% Chance of Green Status			Lower Benchmark : 25th percentile (95% CI)	Upper Benchmark : 50th percentile (95% CI)	Lower Benchmark S_{GEN} (95% CI)	Upper Benchmark 80% S_{MSY} (95% CI)
Dean River	2217	33	TBA		0%	0%	100%	NA	NA	1300	2000	273 (93-711)	697 (521-1035)
Docee	NA	30	TBA		NA	NA	NA	NA	NA	NA	NA	NA	NA
NCC-early timing	891	33	TBA		0%	0%	100%	NA	NA	602	702	141.04 (82-255)	356 (289-469)
NCC-late timing	NA	24	TBA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Rivers Inlet	817	38	TBA		33%	39%	27%	NA	NA	725	1381	665 (330-5046)	972 (543-5506)
Wannock	6468	38	TBA		5%	4%	91%	NA	NA	5535	6599	1798 (657-	3493 (2443-

Conservation Unit	Current Abundance	Years of Data	# of spawner-recruitment pairs	Biological Status						Status Metrics			
				Percentile	Spawner-Recruitment			WSP	COSEWIC	Percentile		Spawner-Recruitment	
					% Chance of Red Status	% Chance of Amber Status	% Chance of Green Status			Lower Benchmark: 25th percentile (95% CI)	Upper Benchmark: 50th percentile (95% CI)	Lower Benchmark S_{GEN} (95% CI)	Upper Benchmark 80% S_{MSY} (95% CI)
												8759)	11418)
Chum													
Bella Coola-Dean Rivers	193293	64	TBA		0%	1%	99%	NA	NA	109704	185662	74033 (60235-103465)	118453 (96376-165544)
Bella Coola River-Late	NA	15	TBA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Douglas-Gardner	152789	64	TBA		1%	37%	62%	NA	NA	80701	155740	91127 (70694-134648)	145804 (113113-215449)
Hecate Lowlands	58484	64	TBA		4%	84%	12%	NA	NA	80612	102579	41975 (33819-62248)	67168 (54133-99717)
Mussel-Kynock	51692	64	TBA		0%	44%	56%	NA	NA	57727	108788	31803 (26988-	50886 (43180-

Conservation Unit	Current Abundance	Years of Data	# of spawner-recruitment pairs	Biological Status						Status Metrics			
				Percentile	Spawner-Recruitment			WSP	COSEWIC	Percentile		Spawner-Recruitment	
					% Chance of Red Status	% Chance of Amber Status	% Chance of Green Status			Lower Benchmark : 25th percentile (95% CI)	Upper Benchmark : 50th percentile (95% CI)	Lower Benchmark S_{GEN} (95% CI)	Upper Benchmark 80% S_{MSY} (95% CI)
												40579)	64926)
Rivers Inlet	3334	62	TBA		100%	0%	0%	NA	NA	8288	17015	13586 (7102-19228)	21861 (16475-30763)
Smith Inlet	10458	63	TBA		93%	7%	0%	NA	NA	23831	43179	15625 (6759-22988)	25079 (19579-36800)
Spiller-Fitz-Hugh-Burke	197474	64	TBA		0%	3%	97%	NA	NA	165933	246521	85621 (69686-125421)	137015 (111548-201038)
Wannock	NA	NA	TBA		NA	NA	NA	NA	NA	NA	NA	NA	NA
Coho													
Bella Coola-Dean Rivers	21964	64	TBA		0%	25%	75%	NA	NA	20163	33069	12627 (6169-	20293 (16700-

Conservation Unit	Current Abundance	Years of Data	# of spawner-recruitment pairs	Biological Status						Status Metrics			
				Percentile	Spawner-Recruitment			WSP	COSEWIC	Percentile		Spawner-Recruitment	
					% Chance of Red Status	% Chance of Amber Status	% Chance of Green Status			Lower Benchmark: 25th percentile (95% CI)	Upper Benchmark: 50th percentile (95% CI)	Lower Benchmark S_{GEN} (95% CI)	Upper Benchmark 80% S_{MSY} (95% CI)
												16563)	26500)
Brim-Wahoo	6629	57	TBA		8%	4%	87%	NA	NA	2850	4725	2342 (1033-10614)	3444 (1901-13523)
Douglas Channel-Kitimat Arm	128750	55	TBA		0%	0%	100%	NA	NA	33346	78595	18308 (4473-25277)	30560 (23490-40458)
Hecate Strait Mainland	73085	64	TBA		0%	0%	100%	NA	NA	78619	123562	34629 (30824-37757)	55405 (49319-60411)
Mussel-Kynoch	5121	62	TBA		11%	28%	61%	NA	NA	2952	4917	3246 (2002-7808)	4803 (3324-9880)

Conservation Unit	Current Abundance	Years of Data	# of spawner-recruitment pairs	Biological Status						Status Metrics			
				Percentile	Spawner-Recruitment			WSP	COSEWIC	Percentile		Spawner-Recruitment	
					% Chance of Red Status	% Chance of Amber Status	% Chance of Green Status			Lower Benchmark : 25th percentile (95% CI)	Upper Benchmark : 50th percentile (95% CI)	Lower Benchmark S_{GEN} (95% CI)	Upper Benchmark 80% S_{MSY} (95% CI)
N Coastal Streams	137078	64	TBA		0%	0%	100%	NA	NA	76474	109608	30393 (28449-32199)	48628 (45518-51519)
Rivers Inlet	NA	48	TBA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Smith Inlet	11608	35	TBA		4%	5%	91%	NA	NA	1967	6505	3992 (1779-12432)	5246 (1957-16818)
Pink (odd-year)													
Hecate Strait-Fjords (odd)	1590166	32	TBA		3%	6%	91%	NA	NA	645825	1101868	6252575 (419906-1862093)	1007944 (713738-2033506)
Hecate Strait-Lowlands (odd)	214950	32	TBA		55%	45%	0%	NA	NA	378873	601260	219014 (171119-369924)	350957 (276282-623146)

Conservation Unit	Current Abundance	Years of Data	# of spawner-recruitment pairs	Biological Status						Status Metrics			
				Percentile	Spawner-Recruitment			WSP	COSEWIC	Percentile		Spawner-Recruitment	
					% Chance of Red Status	% Chance of Amber Status	% Chance of Green Status			Lower Benchmark : 25th percentile (95% CI)	Upper Benchmark : 50th percentile (95% CI)	Lower Benchmark S_{GEN} (95% CI)	Upper Benchmark 80% S_{MSY} (95% CI)
Homathko-Klinaklini-Rivers-Smith-Bella Coola Dean (odd)	8022983	31	TBA		1%	1%	99%	NA	NA	510590	1401031	526826 (374970-1108285)	846215 (616018-2287464)
Pink (even-year)													
Hecate Lowlands (even)	263258	32	TBA		73%	27%	0%	NA	NA	483628	815383	319828 (0-2.76e+12)	583430 (355241-5.17e+12)
Hecate Strait-Fjords (even)	5784381	32	TBA		1%	2%	97%	NA	NA	1983316	3310149	1605490 (1057443-3813005)	2569289 (1695149-6114142)
Sockeye (lake-type)													

Conservation Unit	Current Abundance	Years of Data	# of spawner-recruitment pairs	Biological Status						Status Metrics			
				Percentile	Spawner-Recruitment			WSP	COSEWIC	Percentile		Spawner-Recruitment	
					% Chance of Red Status	% Chance of Amber Status	% Chance of Green Status			Lower Benchmark : 25th percentile (95% CI)	Upper Benchmark : 50th percentile (95% CI)	Lower Benchmark S_{GEN} (95% CI)	Upper Benchmark 80% S_{MSY} (95% CI)
Backland	79	28	TBA		100%	0%	0%	NA	NA	50	80	702.36 (331.38-1779.52)	780 (303-2115)
Banks	NA	NA	TBA		NA	NA	NA	NA	NA	NA	NA	NA (NA-NA)	NA (NA-NA)
Bloomfield	471	58	TBA		69%	30%	0%	NA	NA	402.5	800	543.15 (318.05-1552.43)	903 (589-2225)
Bolton Creek	NA	NA	TBA		NA	NA	NA	NA	NA	NA	NA	NA (NA-NA)	NA (NA-NA)
Bonilla	NA	NA	TBA		NA	NA	NA	NA	NA	NA	NA	NA (NA-NA)	NA (NA-NA)
Borrowman Creek	NA	NA	TBA		NA	NA	NA	NA	NA	NA	NA	NA (NA-NA)	NA (NA-NA)

Conservation Unit	Current Abundance	Years of Data	# of spawner-recruitment pairs	Biological Status						Status Metrics			
				Percentile	Spawner-Recruitment			WSP	COSEWIC	Percentile		Spawner-Recruitment	
					% Chance of Red Status	% Chance of Amber Status	% Chance of Green Status			Lower Benchmark : 25th percentile (95% CI)	Upper Benchmark : 50th percentile (95% CI)	Lower Benchmark S_{GEN} (95% CI)	Upper Benchmark 80% S_{MSY} (95% CI)
Busey Creek	NA	NA	TBA		NA	NA	NA	NA	NA	NA	NA	NA (NA-NA)	NA (NA-NA)
Canoona	2937	43	TBA		0%	0%	100%	NA	NA	1400	3210	561.81 (293.41-1181.64)	1660 (1336-2308)
Cartwright Creek	NA	NA	TBA		NA	NA	NA	NA	NA	NA	NA	NA (NA-NA)	NA (NA-NA)
Chic Chic	NA	NA	TBA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Citeyats	NA	NA	TBA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Curtis Inlet	2710	47	TBA		88%	8%	4%	NA	NA	3100	7000	3806 (2083-164620)	4806 (2438-8097628)
Dallain	NA	NA	TBA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Conservation Unit	Current Abundance	Years of Data	# of spawner-recruitment pairs	Biological Status						Status Metrics			
				Percentile	Spawner-Recruitment			WSP	COSEWIC	Percentile		Spawner-Recruitment	
					% Chance of Red Status	% Chance of Amber Status	% Chance of Green Status			Lower Benchmark : 25th percentile (95% CI)	Upper Benchmark : 50th percentile (95% CI)	Lower Benchmark S_{GEN} (95% CI)	Upper Benchmark 80% S_{MSY} (95% CI)
Creek													
Deer	NA	NA	TBA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Devon	5018	53	TBA		1%	1%	99%	NA	NA	3000	6000	1803 (1113-3438)	2707 (1781-4431)
Dome	NA	NA	TBA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Douglas Creek	NA	NA	TBA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Elizabeth	NA	NA	TBA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Elsie/Hoy	NA	NA	TBA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
End Hill	NA	NA	TBA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Conservation Unit	Current Abundance	Years of Data	# of spawner-recruitment pairs	Biological Status						Status Metrics			
				Percentile	Spawner-Recruitment			WSP	COSEWIC	Percentile		Spawner-Recruitment	
					% Chance of Red Status	% Chance of Amber Status	% Chance of Green Status			Lower Benchmark : 25th percentile (95% CI)	Upper Benchmark : 50th percentile (95% CI)	Lower Benchmark S_{GEN} (95% CI)	Upper Benchmark 80% S_{MSY} (95% CI)
Creek													
Evelyn	2277	60	TBA		10%	5%	84%	NA	NA	600	1500	732.87 (289-747274)	1222 (758-118687468)
Evinrude Inlet	NA	NA	TBA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Fannie Cove	NA	NA	TBA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Freeda	NA	27	TBA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Hartley Bay	962	51	TBA		3%	1%	95%	NA	NA	800	1000	314.99 (159.18-1364.83)	490 (313-2068.25)
Hevenor	NA	NA	TBA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Conservation Unit	Current Abundance	Years of Data	# of spawner-recruitment pairs	Biological Status						Status Metrics			
				Percentile	Spawner-Recruitment			WSP	COSEWIC	Percentile		Spawner-Recruitment	
					% Chance of Red Status	% Chance of Amber Status	% Chance of Green Status			Lower Benchmark : 25th percentile (95% CI)	Upper Benchmark : 50th percentile (95% CI)	Lower Benchmark S_{GEN} (95% CI)	Upper Benchmar k 80% S_{MSY} (95% CI)
Inlet													
Higgins Lagoon	NA	NA	TBA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Kadjusdis River	1612	48	TBA		74%	24%	1%	NA	NA	977.5	2028	2266.1 (879.27-8094.51)	3743 (1786.98-12423.1)
Kainet Creek	2423	55	TBA		1%	1%	98%	NA	NA	850	1500	457.14 (204.33-1384.24)	994 (674-2160.05)
Kdelmashan Creek	NA	NA	TBA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Keecha	2284	40	TBA		3%	6%	91%	NA	NA	1900	4000	1101.1 (657.35-2403.53)	1462 (709-3014)

Conservation Unit	Current Abundance	Years of Data	# of spawner-recruitment pairs	Biological Status						Status Metrics			
				Percentile	Spawner-Recruitment			WSP	COSEWIC	Percentile		Spawner-Recruitment	
					% Chance of Red Status	% Chance of Amber Status	% Chance of Green Status			Lower Benchmark : 25th percentile (95% CI)	Upper Benchmark : 50th percentile (95% CI)	Lower Benchmark S_{GEN} (95% CI)	Upper Benchmark 80% S_{MSY} (95% CI)
Kent Inlet Lagoon Creek	NA	NA	TBA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Kenzuwash Creeks	NA	NA	TBA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Keswar Creek	NA	NA	TBA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Kildidt Creek	NA	NA	TBA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Kildidt Lagoon Creek	NA	NA	TBA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Kimsquit	NA	NA	TBA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Kisameet	NA	NA	TBA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Conservation Unit	Current Abundance	Years of Data	# of spawner-recruitment pairs	Biological Status						Status Metrics			
				Percentile	Spawner-Recruitment			WSP	COSEWIC	Percentile		Spawner-Recruitment	
					% Chance of Red Status	% Chance of Amber Status	% Chance of Green Status			Lower Benchmark : 25th percentile (95% CI)	Upper Benchmark : 50th percentile (95% CI)	Lower Benchmark S_{GEN} (95% CI)	Upper Benchmark 80% S_{MSY} (95% CI)
Kitkiata	NA	NA	TBA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Kitlope	18148	61	TBA		69%	29%	2%	NA	NA	16000	28000	23033 (0-40042084)	41459 (19269-1.59e+11)
Koeye	21940	49	TBA		0%	0%	100%	NA	NA	2000	4000	1917 (1166-4326)	2557 (1473-5317)
Kooryet	2390	44	TBA		12%	8%	80%	NA	NA	1480	4850	1416 (774-19131)	1709 (794-157347)
Kunsoot River	NA	NA	TBA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Kwakwa Creek	NA	50	TBA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Conservation Unit	Current Abundance	Years of Data	# of spawner-recruitment pairs	Biological Status						Status Metrics			
				Percentile	Spawner-Recruitment			WSP	COSEWIC	Percentile		Spawner-Recruitment	
					% Chance of Red Status	% Chance of Amber Status	% Chance of Green Status			Lower Benchmark : 25th percentile (95% CI)	Upper Benchmark : 50th percentile (95% CI)	Lower Benchmark S_{GEN} (95% CI)	Upper Benchmark 80% S_{MSY} (95% CI)
Lewis Creek	NA	NA	TBA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Limestone Creek	NA	NA	TBA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Long	91287	61	TBA		2%	10%	88%	NA	NA	26827	84098	38342 (25707-83922)	61347 (41165-134275)
Lowe/Simpson/Weir	12880	46	TBA		0%	0%	100%	NA	NA	4550	7000	3161 (23059-4793)	4358 (2675-6540)
Mary Cove Creek	280	52	TBA		100%	0%	0%	NA	NA	330	850	2449.25 (1231-6717)	2966 (1258-8491)
Mcdonald Creek	NA	NA	TBA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Conservation Unit	Current Abundance	Years of Data	# of spawner-recruitment pairs	Biological Status						Status Metrics			
				Percentile	Spawner-Recruitment			WSP	COSEWIC	Percentile		Spawner-Recruitment	
					% Chance of Red Status	% Chance of Amber Status	% Chance of Green Status			Lower Benchmark : 25th percentile (95% CI)	Upper Benchmark : 50th percentile (95% CI)	Lower Benchmark S_{GEN} (95% CI)	Upper Benchmark 80% S_{MSY} (95% CI)
Mcloughlin	NA	NA	TBA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Mikado	3990	48	TBA		0%	0%	100%	NA	NA	3000	4405	1149 (743-1823)	2054 (1732-2603)
Monckton Inlet Creek	NA	NA	TBA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Namu	4000	48	TBA		9%	4%	87%	NA	NA	1500	3000	1414.94 (690-494510)	2107 (1277-18282905)
Owikeno	251925	64	TBA		61%	38%	1%	NA	NA	186491	410601	293869 (0-3.72e+12)	600923 (273268-6.62e+12)
Pine River	NA	NA	TBA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Conservation Unit	Current Abundance	Years of Data	# of spawner-recruitment pairs	Biological Status						Status Metrics			
				Percentile	Spawner-Recruitment			WSP	COSEWIC	Percentile		Spawner-Recruitment	
					% Chance of Red Status	% Chance of Amber Status	% Chance of Green Status			Lower Benchmark : 25th percentile (95% CI)	Upper Benchmark : 50th percentile (95% CI)	Lower Benchmark S_{GEN} (95% CI)	Upper Benchmark 80% S_{MSY} (95% CI)
Port John	1396	43	TBA		0%	0%	100%	NA	NA	276	600	297 (171-657)	436 (234-877)
Powles Creek	NA	NA	TBA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Price Creek	NA	NA	TBA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Roderick	502	41	TBA		51%	16%	32%	NA	NA	400	500	513 (0-12006136)	655 (260-314139790)
Ryan Creek	NA	NA	TBA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Salter	NA	NA	TBA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Scoular/Kilp	NA	NA	TBA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Conservation Unit	Current Abundance	Years of Data	# of spawner-recruitment pairs	Biological Status						Status Metrics			
				Percentile	Spawner-Recruitment			WSP	COSEWIC	Percentile		Spawner-Recruitment	
					% Chance of Red Status	% Chance of Amber Status	% Chance of Green Status			Lower Benchmark : 25th percentile (95% CI)	Upper Benchmark : 50th percentile (95% CI)	Lower Benchmark S_{GEN} (95% CI)	Upper Benchmark 80% S_{MSY} (95% CI)
atrick													
Sheneeza Inlet	NA	NA	TBA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Ship Point Creek	NA	NA	TBA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Soda Creek	NA	NA	TBA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
South Atnarko Lakes	4330	46	TBA		100%	0%	0%	NA	NA	8004	22000	10213 (6106-22414)	14108 (7945-33402)
Spencer Creek	NA	NA	TBA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Stannard Creek	NA	NA	TBA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Conservation Unit	Current Abundance	Years of Data	# of spawner-recruitment pairs	Biological Status						Status Metrics			
				Percentile	Spawner-Recruitment			WSP	COSEWIC	Percentile		Spawner-Recruitment	
					% Chance of Red Status	% Chance of Amber Status	% Chance of Green Status			Lower Benchmark : 25th percentile (95% CI)	Upper Benchmark : 50th percentile (95% CI)	Lower Benchmark S_{GEN} (95% CI)	Upper Benchmar k 80% S_{MSY} (95% CI)
Talamoosa Creek	NA	NA	TBA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Tankeeah River	9747	52	TBA		1%	2%	96%	NA	NA	2000	3400	2515 (1127-8146)	3639 (1924-11127)
Treneman Creek	NA	NA	TBA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Tsimtack/ Moore/Roger	5585	41	TBA		0%	0%	100%	NA	NA	1500	3000	787.68 (376-1475)	1555 (934-2420)
Tuno Creek East	NA	NA	TBA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Tuno Creek West	NA	NA	TBA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Conservation Unit	Current Abundance	Years of Data	# of spawner-recruitment pairs	Biological Status						Status Metrics			
				Percentile	Spawner-Recruitment			WSP	COSEWIC	Percentile		Spawner-Recruitment	
					% Chance of Red Status	% Chance of Amber Status	% Chance of Green Status			Lower Benchmark : 25th percentile (95% CI)	Upper Benchmark : 50th percentile (95% CI)	Lower Benchmark S_{GEN} (95% CI)	Upper Benchmark 80% S_{MSY} (95% CI)
Tyler Creek	NA	NA	TBA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Wale Creek	NA	NA	TBA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Wannock (Owikeno)	NA	NA	TBA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Watt Bay	NA	NA	TBA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
West Creek	NA	NA	TBA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Yaaklele Lagoon	NA	NA	TBA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Yeo	1032	48	TBA		1%	4%	95%	NA	NA	375	950	394 (220-901)	605 (370-1197)
Sockeye (river-type)													

Conservation Unit	Current Abundance	Years of Data	# of spawner-recruitment pairs	Biological Status						Status Metrics			
				Percentile	Spawner-Recruitment			WSP	COSEWIC	Percentile		Spawner-Recruitment	
					% Chance of Red Status	% Chance of Amber Status	% Chance of Green Status			Lower Benchmark : 25th percentile (95% CI)	Upper Benchmark : 50th percentile (95% CI)	Lower Benchmark S_{GEN} (95% CI)	Upper Benchmark 80% S_{MSY} (95% CI)
Northern Coastal	NA	NA	TBA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Northern Coastal Fjords	NA	58	TBA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Rivers-Smith Inlets	NA	NA	TBA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Fraser Region

Table A. 11. Shows summary statistics, biological status assessments, and benchmarks values for Fraser Region Conservation Units (CUs).

Current abundance is expressed as the average over the most recent generation, shown in parentheses. Years of Data shows the number of years over the time series with CU-level estimates of spawner abundance. For the spawner-recruitment metric, the percentage in each column is the probability (%) of a given status based on the benchmarks (SGEN and 80% SMSY) estimated from a Hierarchical Bayesian Model. For the spawner-recruitment benchmark values, 95% credible intervals are shown in parentheses. The percentile benchmark values show 95% confidence intervals in parentheses. The Pacific Salmon Foundation benchmark method and status shown on the Pacific Salmon Explorer for each CU are noted by the highlighted status color.

Conservation Unit	Current Abundance	Years of Data	# of spawner-recruitment pairs	Biological Status						Status Metrics			
				Percentile	Spawner-Recruitment			WSP	COSEWIC	Percentile		Spawner-Recruitment	
					% Chance of Red Status	% Chance of Amber Status	% Chance of Green Status			Lower Benchmark 25th percentile (95% CI)	Upper Benchmark 50th percentile (95% CI)	Lower Benchmark S_{GEN} (95% CI)	Upper Benchmark 80% S_{MSY} (95% CI)
Chinook													
Boundary Bay (Fall 4_1)	NA	24	TBA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Lower Fraser River (Fall 4_1)	NA	35	TBA	NA	NA	NA	NA		Threatened	NA	NA	NA	NA
Lower Fraser River (Spring 5_2)	NA	24	TBA	NA	NA	NA	NA	Not Assessed	Special Concern	NA	NA	NA	NA
Lower Fraser River (Summer 5_2)	NA	14	TBA	NA	NA	NA	NA	Data Deficient	Threatened	NA	NA	NA	NA

Conservation Unit	Current Abundance	Years of Data	# of spawner-recruitment pairs	Biological Status						Status Metrics			
				Percentile	Spawner-Recruitment			WSP	COSEWIC	Percentile		Spawner-Recruitment	
					% Chance of Red Status	% Chance of Amber Status	% Chance of Green Status			Lower Benchmark 25th percentile (95% CI)	Upper Benchmark 50th percentile (95% CI)	Lower Benchmark S_{GEN} (95% CI)	Upper Benchmark 80% S_{MSY} (95% CI)
Lower Fraser River-Upper Pitt (Summer 5_2)	NA	14	TBA	NA	NA	NA	NA	Data Deficient	Endangered	NA	NA	NA	NA
Lower Thompson (Spring 4_2)	NA	24	TBA	NA	NA	NA	NA		Not Assessed	NA	NA	NA	NA
Maria Slough (Summer 4_1)	NA	22	TBA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Middle Fraser River (Spring 5_2)	NA	24	TBA	NA	NA	NA	NA		Threatened				
Middle Fraser River (Summer 5_2)	NA	20	TBA	NA	NA	NA	NA		Threatened	NA	NA	NA	NA
Middle Fraser River-Portage (Fall	NA	19	TBA	NA	NA	NA	NA		Endangered	NA	NA	NA	NA

Conservation Unit	Current Abundance	Years of Data	# of spawner-recruitment pairs	Biological Status						Status Metrics			
				Percentile	Spawner-Recruitment			WSP	COSEWIC	Percentile		Spawner-Recruitment	
					% Chance of Red Status	% Chance of Amber Status	% Chance of Green Status			Lower Benchmark 25th percentile (95% CI)	Upper Benchmark 50th percentile (95% CI)	Lower Benchmark S_{GEN} (95% CI)	Upper Benchmark 80% S_{MSY} (95% CI)
5_2)													
Middle Fraser-Fraser Canyon (Spring 5_2)	NA	17	TBA	NA	NA	NA	NA	Data Deficient	Endangered	NA	NA	NA	NA
North Thompson (Spring 5_2)	NA	20	TBA	NA	NA	NA	NA		Endangered	NA	NA	NA	NA
North Thompson (Summer 5_2)	NA	22	TBA	NA	NA	NA	NA		Endangered	NA	NA	NA	NA
Shuswap River (Summer 4_1)	NA	24	TBA	NA	NA	NA	NA	NA	Not at risk	NA	NA	NA	NA
South Thompson (Summer 4_1)	NA	22	TBA	NA	NA	NA	NA		Not at risk	NA	NA	NA	NA

Conservation Unit	Current Abundance	Years of Data	# of spawner-recruitment pairs	Biological Status						Status Metrics			
				Percentile	Spawner-Recruitment			WSP	COSEWIC	Percentile		Spawner-Recruitment	
					% Chance of Red Status	% Chance of Amber Status	% Chance of Green Status			Lower Benchmark 25th percentile (95% CI)	Upper Benchmark 50th percentile (95% CI)	Lower Benchmark S_{GEN} (95% CI)	Upper Benchmark 80% S_{MSY} (95% CI)
South Thompson (Summer 5_2)	NA	20	TBA	NA	NA	NA	NA		NA	NA	NA	NA	
South Thompson-Bessette Creek (Summer 4_2)	NA	23	TBA	NA	NA	NA	NA		Endangered	NA	NA	NA	NA
Upper Adams River (Summer x.x)	NA	14	TBA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Upper Fraser River (Spring 5_2)	NA	24	TBA	NA	NA	NA	NA		Endangered	NA	NA	NA	NA
Chum													
Lower Fraser	NA	NA	TBA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Conservation Unit	Current Abundance	Years of Data	# of spawner-recruitment pairs	Biological Status						Status Metrics			
				Percentile	Spawner-Recruitment			WSP	COSEWIC	Percentile		Spawner-Recruitment	
					% Chance of Red Status	% Chance of Amber Status	% Chanc e of Green Status			Lower Benchmark 25th percentile (95% CI)	Upper Benchmark 50th percentile (95% CI)	Lower Benchmark S_{GEN} (95% CI)	Upper Benchmark 80% S_{MSY} (95% CI)
Coho													
Boundary Bay	NA	NA	TBA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Fraser Canyon	753	33	TBA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Interior Fraser	3946	33	TBA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Lillooet	NA	NA	TBA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Lower Fraser	NA	NA	TBA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Lower Thompson	8052	33	TBA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
North Thompson	6243	33	TBA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Conservation Unit	Current Abundance	Years of Data	# of spawner-recruitment pairs	Biological Status						Status Metrics			
				Percentile	Spawner-Recruitment			WSP	COSEWIC	Percentile		Spawner-Recruitment	
					% Chance of Red Status	% Chance of Amber Status	% Chance of Green Status			Lower Benchmark 25th percentile (95% CI)	Upper Benchmark 50th percentile (95% CI)	Lower Benchmark S_{GEN} (95% CI)	Upper Benchmark 80% S_{MSY} (95% CI)
South Thompson	4337	33	TBA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Pink (odd year)													
Fraser River	3392159	30	TBA		88%	12%	0%	NA	NA	1861664 (1475092-6803771)	4024495 (2301494-10964800)	4429008 (0-12965968)	7256104 (4929169-1187043880)
Sockeye (lake-type)													
Adams & Momich Lakes-Early Summer ***(de novo)***	NA	NA	TBA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Adams-Early Summer (*EXTINCT*)	NA	NA	TBA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Conservation Unit	Current Abundance	Years of Data	# of spawner-recruitment pairs	Biological Status						Status Metrics			
				Percentile	Spawner-Recruitment			WSP	COSEWIC	Percentile		Spawner-Recruitment	
					% Chance of Red Status	% Chance of Amber Status	% Chance of Green Status			Lower Benchmark 25th percentile (95% CI)	Upper Benchmark 50th percentile (95% CI)	Lower Benchmark S_{GEN} (95% CI)	Upper Benchmark 80% S_{MSY} (95% CI)
Alouette-Early Summer (*EXTINCT*)	NA	NA	TBA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Anderson/ Seton-Early Summer	11004	50	TBA		78%	22%	0%		Not at risk	4036 (2278-6391)	7897 (4682-13212)	41923 (0-21473368)	76472 (16798-176780340)
Bowron-Early Summer	1103	68	TBA		99%	1%	0%		Endangered	2322 (1494-3368)	4853 (3127-6843)	7599 (2254-6713083)	25476 (10749-26734648)
Cariboo-Summer (*EXTINCT*)	NA	NA	TBA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chilko-Early Summer	NA	NA	TBA	NA	NA	NA	NA		Not at risk	NA	NA	NA	NA

Conservation Unit	Current Abundance	Years of Data	# of spawner-recruitment pairs	Biological Status						Status Metrics			
				Percentile	Spawner-Recruitment			WSP	COSEWIC	Percentile		Spawner-Recruitment	
					% Chance of Red Status	% Chance of Amber Status	% Chance of Green Status			Lower Benchmark 25th percentile (95% CI)	Upper Benchmark 50th percentile (95% CI)	Lower Benchmark S_{GEN} (95% CI)	Upper Benchmark 80% S_{MSY} (95% CI)
Chilko-Summer	435074	68	TBA		3%	40%	57%		Not at risk	140373 (101473-249817)	358625 (239045-457873)	262710 (194543-445124)	420350 (311357-712306)
Chilliwack-Early Summer	NA	45	TBA	NA	NA	NA	NA		Not at risk	NA	NA	NA	NA
Coquitlam-Early Summer (*EXTINCT*)	NA	NA	TBA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Cultus-Late	1170	68	TBA	NA	NA	NA	NA		Endangered	NA	NA	NA	NA
Francois/ Fraser-Summer	106412	68	TBA		33%	52%	15%		Special Concern	41103 (9688-17486)	88244 (16116-28697)	89396 (53976-1142845)	143888 (88436-3553001)
Fraser-Early Summer	NA	NA	TBA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Conservation Unit	Current Abundance	Years of Data	# of spawner-recruitment pairs	Biological Status						Status Metrics			
				Percentile	Spawner-Recruitment			WSP	COSEWIC	Percentile		Spawner-Recruitment	
					% Chance of Red Status	% Chance of Amber Status	% Chanc e of Green Status			Lower Benchmark 25th percentile (95% CI)	Upper Benchmark 50th percentile (95% CI)	Lower Benchmark S_{GEN} (95% CI)	Upper Benchmark 80% S_{MSY} (95% CI)
(*EXTINCT*)													
Harrison-downstream migrating-Late	9557	64	TBA		NA	NA	NA		Special Concern	540 (345-1537)	2718 (1184-5878)	NA	NA
Harrison-upstream migrating-Late	4682	52	TBA		95%	5%	0%		Endangered	22451 (9058-30345)	38752 (26016-52345)	90719 (0-39832354)	170219 (42975-507806678)
Indian/Kruger-Early Summer (*EXTINCT*)	NA	NA	TBA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Kamloops-Early Summer	9500	68	TBA		37%	63%	0%		Special Concern	2958 (1923-4583)	6160 (4194-7711)	6335 (2748-1218509)	20990 (11476-3384820)
Kawkawa-Late	NA	NA	TBA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Conservation Unit	Current Abundance	Years of Data	# of spawner-recruitment pairs	Biological Status						Status Metrics			
				Percentile	Spawner-Recruitment			WSP	COSEWIC	Percentile		Spawner-Recruitment	
					% Chance of Red Status	% Chance of Amber Status	% Chance of Green Status			Lower Benchmark 25th percentile (95% CI)	Upper Benchmark 50th percentile (95% CI)	Lower Benchmark S_{GEN} (95% CI)	Upper Benchmark 80% S_{MSY} (95% CI)
(*EXTINCT*)													
Lillooet /Harrison-Late	30712	67	TBA		100%	0%	0%		Special Concern	40298 (31418-49572)	54354 (47237-76927)	52287 (37972-98035)	83674 (60806-157505)
Momich-Early Summer (*EXTINCT*)	NA	NA	TBA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Nadina/ Francois-Early Summer	10194	45	TBA		13%	87%	0%		Not at risk	742 (359-1960)	2965 (1495-4722)	1607 (691-38764)	24698 (14189-62022)
Nadina/ Francois-Early Summer (First and Second Runs)	NA	NA	TBA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Conservation Unit	Current Abundance	Years of Data	# of spawner-recruitment pairs	Biological Status						Status Metrics			
				Percentile	Spawner-Recruitment			WSP	COSEWIC	Percentile		Spawner-Recruitment	
					% Chance of Red Status	% Chance of Amber Status	% Chance of Green Status			Lower Benchmark 25th percentile (95% CI)	Upper Benchmark 50th percentile (95% CI)	Lower Benchmark S_{GEN} (95% CI)	Upper Benchmark 80% S_{MSY} (95% CI)
(*EXTINCT*)													
Nahatlatch-Early Summer	6377	42	TBA		NA	NA	NA		Special Concern	3554 (2156-5353)	5664 (3696-10045)	NA	NA
North Barriere-Early Summer (*EXTINCT*)	NA	NA	TBA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
North Barriere-Early Summer ***(de novo)***	1768	51	TBA		9%	91%	0%		Threatened	1250 (416-3267)	4901 (1471-8393)	968 (469-2703)	5625 (4080-10486)
Pitt-Early Summer	19870	68	TBA		0%	45%	54%		Not at risk	13694 (9819-17460)	20752 (16165-28991)	5110 (3157-16426)	19598 (15862-26862)

Conservation Unit	Current Abundance	Years of Data	# of spawner-recruitment pairs	Biological Status						Status Metrics			
				Percentile	Spawner-Recruitment			WSP	COSEWIC	Percentile		Spawner-Recruitment	
					% Chance of Red Status	% Chance of Amber Status	% Chance of Green Status			Lower Benchmark 25th percentile (95% CI)	Upper Benchmark 50th percentile (95% CI)	Lower Benchmark S_{GEN} (95% CI)	Upper Benchmark 80% S_{MSY} (95% CI)
Quesnel-Summer	NA	68	TBA	NA	NA	NA	NA		Endangered	NA	NA	NA	NA
Seton-Summer (*EXTINCT*)	NA	NA	TBA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Seton-Late ***(de novo)***	444	63	TBA		98%	2%	0%		Endangered	1214 (561-2476)	3625 (2178-6271)	21640 (1197 - 18866517)	39026 (9205-95451119)
Shuswap-Early Summer	NA	68	TBA	NA	NA	NA	NA		Not at risk	NA	NA	NA	NA
Shuswap-Late	NA	68	TBA	NA	NA	NA	NA		Not at risk	NA	NA	NA	NA
Takla/ Trembleur/ Stuart-Summer	NA	68	TBA	NA	NA	NA	NA		Endangered	NA	NA	NA	NA

Conservation Unit	Current Abundance	Years of Data	# of spawner-recruitment pairs	Biological Status						Status Metrics			
				Percentile	Spawner-Recruitment			WSP	COSEWIC	Percentile		Spawner-Recruitment	
					% Chance of Red Status	% Chance of Amber Status	% Chance of Green Status			Lower Benchmark 25th percentile (95% CI)	Upper Benchmark 50th percentile (95% CI)	Lower Benchmark S_{GEN} (95% CI)	Upper Benchmark 80% S_{MSY} (95% CI)
Takla/ Trembleur-Early Stuart	NA	68	TBA	NA	NA	NA	NA		Endangered	NA	NA	NA	NA
Taseko-Early Summer	516	51	TBA		NA	NA	NA		Endangered	733 (314-1643)	1960 (1101-4488)	NA	NA
Sockeye (river-type)													
Harrison River	109923	68	TBA		42%	35%	24%		Not at risk	4435 (2188-10669)	13639 (6352-27611)	95552 (38924-11209273)	157865 (73728-86809633)
Widgeon	360	64	TBA		NA	NA	NA		Threatened	352 (245-751)	1136 (545-1472)	NA	NA

Vancouver Island & Mainland Inlets Region

Table A. 12. Shows summary statistics, biological status assessments, and benchmarks values for the Vancouver Island & Mainland Inlets Region Conservation Units (CUs).

Current abundance is expressed as the average over the most recent generation, shown in parentheses. Years of Data shows the number of years over the time series with CU-level estimates of spawner abundance. For the spawner-recruitment metric, the percentage in each column is the probability (%) of a given status based on the benchmarks (SGEN and 80% SMSY) estimated from a Hierarchical Bayesian Model. For the spawner-recruitment benchmark values, 95% credible intervals are shown in parentheses. The percentile benchmark values show 95% confidence intervals in parentheses. The Pacific Salmon Foundation benchmark method and status shown on the Pacific Salmon Explorer for each CU are noted by the highlighted status color.

Conservation Unit	Current Abundance	Years of Data	# of spawner-recruitment pairs	Biological Status						Status Metrics			
				Percentile	Spawner-Recruitment			WSP	COSEWIC	Percentile		Spawner-Recruitment	
					% Chance of Red Status	% Chance of Amber Status	% Chance of Green Status			Lower Benchmark: 25th percentile (95% CI)	Upper Benchmark: 50th percentile (95% CI)	Lower Benchmark S_{GEN} (95% CI)	Upper Benchmark 80% S_{MSY} (95% CI)
Chinook													
East Vancouver Island-Cowichan and Koksilah (Fall 0.x)	NA	42	TBA	NA	NA	NA	NA	NA	Special Concern	NA	NA	NA	NA

Conservation Unit	Current Abundance	Years of Data	# of spawner-recruitment pairs	Biological Status						Status Metrics			
				Percentile	Spawner-Recruitment			WSP	COSEWIC	Percentile		Spawner-Recruitment	
					% Chance of Red Status	% Chance of Amber Status	% Chance of Green Status			Lower Benchmark: 25th percentile (95% CI)	Upper Benchmark: 50th percentile (95% CI)	Lower Benchmark S_{GEN} (95% CI)	Upper Benchmark 80% S_{MSY} (95% CI)
East Vancouver Island-Georgia Strait (Summer 4_1)	NA	45	TBA	NA	NA	NA	NA	NA	Endangered	NA	NA	NA	NA
East Vancouver Island-Goldstream (Fall 0.x)	NA	22	TBA	NA	NA	NA	NA	NA	Special Concern	NA	NA	NA	NA
East Vancouver Island-Nanaimo (Spring 1.x)	NA	NA	TBA	NA	NA	NA	NA	NA	Endangered	NA	NA	NA	NA
East Vancouver Island-Nanaimo and Chemainus (Fall 0.x)	NA	37	TBA	NA	NA	NA	NA	NA	Special Concern	NA	NA	NA	NA

Conservation Unit	Current Abundance	Years of Data	# of spawner-recruitment pairs	Biological Status						Status Metrics			
				Percentile	Spawner-Recruitment			WSP	COSEWIC	Percentile		Spawner-Recruitment	
					% Chance of Red Status	% Chance of Amber Status	% Chance of Green Status			Lower Benchmark : 25th percentile (95% CI)	Upper Benchmark : 50th percentile (95% CI)	Lower Benchmark S_{GEN} (95% CI)	Upper Benchmark 80% S_{MSY} (95% CI)
East Vancouver Island-North (Fall 0.x)	NA	43	TBA	NA	NA	NA	NA		Not at Risk	NA	NA	NA	NA
East Vancouver Island-Qualicum and Puntledge (Fall 0.x)	NA	45	TBA	NA	NA	NA	NA	NA	Special Concern	NA	NA	NA	NA
Homathko (Summer x.x)	NA	NA	TBA	NA	NA	NA	NA	Data Deficient	Data Deficient	NA	NA	NA	NA
Klinaklini (Summer 5_2)	NA	NA	TBA	NA	NA	NA	NA	Data Deficient	Data Deficient	NA	NA	NA	NA
Southern Mainland-Georgia Strait (Fall 0.x)	NA	35	TBA	NA	NA	NA	NA	NA	Data Deficient	NA	NA	NA	NA

Conservation Unit	Current Abundance	Years of Data	# of spawner-recruitment pairs	Biological Status						Status Metrics			
				Percentile	Spawner-Recruitment			WSP	COSEWIC	Percentile		Spawner-Recruitment	
					% Chance of Red Status	% Chance of Amber Status	% Chance of Green Status			Lower Benchmark: 25th percentile (95% CI)	Upper Benchmark: 50th percentile (95% CI)	Lower Benchmark S_{GEN} (95% CI)	Upper Benchmark 80% S_{MSY} (95% CI)
Southern Mainland-Southern Fjords (Fall 0.x)	NA	24	TBA	NA	NA	NA	NA	NA	Data Deficient	NA	NA	NA	NA
West Vancouver Island-Nootka and Kyuquot (Fall 0.x)	NA	36	TBA	NA	NA	NA	NA		Threatened	NA	NA	NA	NA
West Vancouver Island-North (Fall 0.x)	NA	28	TBA	NA	NA	NA	NA	NA	Data Deficient	NA	NA	NA	NA
West Vancouver Island-South (Fall 0.x)	NA	37	TBA	NA	NA	NA	NA		Threatened	NA	NA	NA	NA
Chum													

Conservation Unit	Current Abundance	Years of Data	# of spawner-recruitment pairs	Biological Status						Status Metrics			
				Percentile	Spawner-Recruitment			WSP	COSEWIC	Percentile		Spawner-Recruitment	
					% Chance of Red Status	% Chance of Amber Status	% Chance of Green Status			Lower Benchmark : 25th percentile (95% CI)	Upper Benchmark : 50th percentile (95% CI)	Lower Benchmark S_{GEN} (95% CI)	Upper Benchmark 80% S_{MSY} (95% CI)
Bute Inlet	NA	53	TBA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Georgia Strait	636779	65	TBA		NA	NA	NA	NA	NA	390114 (307900-475917)	540673 (431901-645779)	NA	NA
Howe Sound-Burrard Inlet	571511	64	TBA		NA	NA	NA	NA	NA	93686 (67449-161324)	183037 (123366-290950)	NA	NA
Loughborough	13175	65	TBA		NA	NA	NA	NA	NA	16392 (12486-18486)	23125 (19145-30283)	NA	NA
Northeast Vancouver Island	3358	65	TBA		NA	NA	NA	NA	NA	13253 (6932-20715)	29678 (16812-48920)	NA	NA

<table>
<tr><th rowspan="3">Conservation Unit</th><th rowspan="3">Current Abundance</th><th rowspan="3">Years of Data</th><th rowspan="3"># of spawner-recruitment pairs</th><th colspan="6">Biological Status</th><th colspan="4">Status Metrics</th></tr>
<tr><th rowspan="2">Percentile</th><th colspan="3">Spawner-Recruitment</th><th rowspan="2">WSP</th><th rowspan="2">COSEWIC</th><th colspan="2">Percentile</th><th colspan="2">Spawner-Recruitment</th></tr>
<tr><th>% Chance of Red Status</th><th>% Chance of Amber Status</th><th>% Chance of Green Status</th><th>Lower Benchmark : 25th percentile (95% CI)</th><th>Upper Benchmark : 50th percentile (95% CI)</th><th>Lower Benchmark S_{GEN} (95% CI)</th><th>Upper Benchmark 80% S_{MSY} (95% CI)</th></tr>
<tr><td>Northwest Vancouver Island</td><td>87848</td><td>63</td><td>TBA</td><td></td><td>0%</td><td>0%</td><td>100%</td><td>NA</td><td>NA</td><td>24811 (20334-32348)</td><td>43325 (30835-56846)</td><td>12279 (9541-16059)</td><td>19531 (15262-25009)</td></tr>
<tr><td>Southern Coastal Streams</td><td>2528</td><td>65</td><td>TBA</td><td></td><td>NA</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td><td>2063 (1021-5234)</td><td>6821 (3060-11951)</td><td>NA</td><td>NA</td></tr>
<tr><td>Southwest & West Vancouver Island</td><td>163575</td><td>63</td><td>TBA</td><td></td><td>0%</td><td>1%</td><td>99%</td><td>NA</td><td>NA</td><td>204065 (161687-259116)</td><td>296538 (248631-331552)</td><td>74604 (60472-97373)</td><td>119366 (96755-155797)</td></tr>
<tr><td colspan="14">Coho</td></tr>
<tr><td>Clayoquot</td><td>NA</td><td>NA</td><td>TBA</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td></tr>
<tr><td>East Vancouver Island-Georgia</td><td>NA</td><td>NA</td><td>TBA</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td></tr>
</table>

Conservation Unit	Current Abundance	Years of Data	# of spawner-recruitment pairs	Biological Status						Status Metrics			
				Percentile	Spawner-Recruitment			WSP	COSEWIC	Percentile		Spawner-Recruitment	
					% Chance of Red Status	% Chance of Amber Status	% Chance of Green Status			Lower Benchmark: 25th percentile (95% CI)	Upper Benchmark: 50th percentile (95% CI)	Lower Benchmark S_{GEN} (95% CI)	Upper Benchmark 80% S_{MSY} (95% CI)
Strait													
East Vancouver Island-Johnstone Strait-Southern Fjords	NA	NA	TBA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Georgia Strait Mainland	NA	NA	TBA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Homathko-Klinaklini Rivers	NA	NA	TBA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Howe Sound-Burrard Inlet	NA	NA	TBA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Juan de Fuca-	NA	NA	TBA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Conservation Unit	Current Abundance	Years of Data	# of spawner-recruitment pairs	Biological Status						Status Metrics			
				Percentile	Spawner-Recruitment			WSP	COSEWIC	Percentile		Spawner-Recruitment	
					% Chance of Red Status	% Chance of Amber Status	% Chance of Green Status			Lower Benchmark: 25th percentile (95% CI)	Upper Benchmark: 50th percentile (95% CI)	Lower Benchmark S_{GEN} (95% CI)	Upper Benchmark 80% S_{MSY} (95% CI)
Pachena													
Nahwitti Lowland	NA	NA	TBA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Southern Coastal Streams-Queen Charlotte Strait-Johnstone Strait-Southern Fjords	NA	NA	TBA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
West Vancouver Island	NA	NA	TBA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Pink (odd-year)													

Conservation Unit	Current Abundance	Years of Data	# of spawner-recruitment pairs	Biological Status						Status Metrics			
				Percentile	Spawner-Recruitment			WSP	COSEWIC	Percentile		Spawner-Recruitment	
					% Chance of Red Status	% Chance of Amber Status	% Chance of Green Status			Lower Benchmark: 25th percentile (95% CI)	Upper Benchmark: 50th percentile (95% CI)	Lower Benchmark S_{GEN} (95% CI)	Upper Benchmark 80% S_{MSY} (95% CI)
East Howe Sound-Burrard Inlet	346526	32	TBA		30%	28%	42%	NA	NA	42183 (21871-74670)	74688 (43546-136811)	101602 (0-13473855742786)	843910 (72254-21581635624784)
East Vancouver Island-Johnstone Strait	434092	32	TBA		13%	12%	74%	NA	NA	13190 (7679-49969)	78111 (21341-140595)	50038 (0-56684030)	95325 (40880-775519620308)
Georgia Strait	3282797	32	TBA		24%	36%	40%	NA	NA	115468 (69927-344619)	320374 (122646-664555)	581367 (0-107307563030760)	12087284 (506348-171692100849216)
Nahwitti	13412	32	TBA		34%	51%	15%	NA	NA	3695 (1909-11440)	12596 (4295-27291)	11554 (0-2152559)	18323 (9851-817647460)

Conservation Unit	Current Abundance	Years of Data	# of spawner-recruitment pairs	Biological Status						Status Metrics			
				Percentile	Spawner-Recruitment			WSP	COSEWIC	Percentile		Spawner-Recruitment	
					% Chance of Red Status	% Chance of Amber Status	% Chance of Green Status			Lower Benchmark: 25th percentile (95% CI)	Upper Benchmark: 50th percentile (95% CI)	Lower Benchmark S_{GEN} (95% CI)	Upper Benchmark 80% S_{MSY} (95% CI)
Southern Fjords	418652	32	TBA		1%	4%	95%	NA	NA	222399 (148410-302595)	283138 (250258-510111)	164246 (122138-307797)	263430 (198630-541287)
West Vancouver Island	NA	NA	TBA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Pink (even-year)													
Georgia Strait	98656	32	TBA		66%	32%	2%			29016 (13287-29509)	101506 (87242-199258)	111666 (43887-913410)	182018 (102578-187357018)
Northwest Vancouver Island	NA	NA	TBA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Southern	704628	32	TBA		5%	68%	27%			616297	1150450	481053	770668

Conservation Unit	Current Abundance	Years of Data	# of spawner-recruitment pairs	Biological Status						Status Metrics			
				Percentile	Spawner-Recruitment			WSP	COSEWIC	Percentile		Spawner-Recruitment	
					% Chance of Red Status	% Chance of Amber Status	% Chance of Green Status			Lower Benchmark: 25th percentile (95% CI)	Upper Benchmark: 50th percentile (95% CI)	Lower Benchmark S_{GEN} (95% CI)	Upper Benchmark 80% S_{MSY} (95% CI)
Fjords										(441478-1157786)	(750255-1796347)	(367055-801439)	(592310-1327955)
West Vancouver Island	NA	NA	TBA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Sockeye (lake-type)													
Alice	NA	NA	TBA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Canoe Creek	NA	NA	TBA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Cecilia	NA	NA	TBA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Cheewat	NA	NA	TBA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Clayoquot	NA	NA	TBA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Conservation Unit	Current Abundance	Years of Data	# of spawner-recruitment pairs	Biological Status						Status Metrics			
				Percentile	Spawner-Recruitment			WSP	COSEWIC	Percentile		Spawner-Recruitment	
					% Chance of Red Status	% Chance of Amber Status	% Chance of Green Status			Lower Benchmark: 25th percentile (95% CI)	Upper Benchmark: 50th percentile (95% CI)	Lower Benchmark S_{GEN} (95% CI)	Upper Benchmark 80% S_{MSY} (95% CI)
Deserted	NA	NA	TBA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Fairy	NA	NA	TBA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Fulmore	NA	NA	TBA		NA	NA	NA	NA	NA	NA	NA	NA	NA
Great Central	209147	41	TBA		1%	5%	93%	NA	NA	138817 (113632-182401)	206677 (166541-235887)	71631 (48211-175783)	114610 (77138-281252)
Henderson	NA	NA	TBA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Hesquiat	NA	NA	TBA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Heydon	NA	NA	TBA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Hobiton	NA	NA	TBA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Conservation Unit	Current Abundance	Years of Data	# of spawner-recruitment pairs	Biological Status						Status Metrics			
				Percentile	Spawner-Recruitment			WSP	COSEWIC	Percentile		Spawner-Recruitment	
					% Chance of Red Status	% Chance of Amber Status	% Chance of Green Status			Lower Benchmark : 25th percentile (95% CI)	Upper Benchmark : 50th percentile (95% CI)	Lower Benchmark S_{GEN} (95% CI)	Upper Benchmark 80% S_{MSY} (95% CI)
Ida/Bonanza	NA	NA	TBA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Jansen	NA	NA	TBA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Kakweiken	NA	NA	TBA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Kanim	NA	NA	TBA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Kennedy	NA	NA	TBA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Loose	NA	NA	TBA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Mackenzie	NA	NA	TBA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Maggie	NA	NA	TBA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Megin	NA	NA	TBA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Conservation Unit	Current Abundance	Years of Data	# of spawner-recruitment pairs	Biological Status						Status Metrics			
				Percentile	Spawner-Recruitment			WSP	COSEWIC	Percentile		Spawner-Recruitment	
					% Chance of Red Status	% Chance of Amber Status	% Chance of Green Status			Lower Benchmark : 25th percentile (95% CI)	Upper Benchmark : 50th percentile (95% CI)	Lower Benchmark S_{GEN} (95% CI)	Upper Benchmark 80% S_{MSY} (95% CI)
Muchalat	NA	NA	TBA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Muriel	NA	NA	TBA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Nahwitti	NA	NA	TBA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Nimpkish	70324	65	TBA		NA	NA	NA	NA	NA	30029 (21224-43935)	60000 (37237-70796)	NA	NA
Nitinat	NA	NA	TBA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
O'Connell	NA	NA	TBA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Park River	NA	NA	TBA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Phillips	NA	NA	TBA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Conservation Unit	Current Abundance	Years of Data	# of spawner-recruitment pairs	Biological Status						Status Metrics			
				Percentile	Spawner-Recruitment			WSP	COSEWIC	Percentile		Spawner-Recruitment	
					% Chance of Red Status	% Chance of Amber Status	% Chance of Green Status			Lower Benchmark: 25th percentile (95% CI)	Upper Benchmark: 50th percentile (95% CI)	Lower Benchmark S_{GEN} (95% CI)	Upper Benchmark 80% S_{MSY} (95% CI)
Power	NA	NA	TBA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Quatse	NA	NA	TBA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Sakinaw	149	NA	TBA	NA	NA	NA	NA	NA	Endangered	NA	NA	NA	NA
Schoen	NA	NA	TBA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Shushartie	NA	NA	TBA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Sproat	329800	41	TBA		0%	1%	99%			131888 (93565-181965)	177831 (137161-249178)	59971 (38887-158070)	95954 (62220-252911)
Tzoonie	NA	NA	TBA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Vernon	NA	NA	TBA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Conservation Unit	Current Abundance	Years of Data	# of spawner-recruitment pairs	Biological Status						Status Metrics			
				Percentile	Spawner-Recruitment			WSP	COSEWIC	Percentile		Spawner-Recruitment	
					% Chance of Red Status	% Chance of Amber Status	% Chance of Green Status			Lower Benchmark: 25th percentile (95% CI)	Upper Benchmark: 50th percentile (95% CI)	Lower Benchmark S_{GEN} (95% CI)	Upper Benchmark 80% S_{MSY} (95% CI)
Village Bay (*EXTINCT*)	NA	NA	TBA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
William/Brink	NA	NA	TBA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Woss	NA	NA	TBA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Sockeye (river-type)													
East Vancouver Island and Georgia Strait	NA	NA	TBA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
NW Vancouver Island	NA	NA	TBA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Southern Fjords	NA	NA	TBA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Conservation Unit	Current Abundance	Years of Data	# of spawner-recruitment pairs	Biological Status						Status Metrics			
				Percentile	Spawner-Recruitment			WSP	COSEWIC	Percentile		Spawner-Recruitment	
					% Chance of Red Status	% Chance of Amber Status	% Chance of Green Status			Lower Benchmark: 25th percentile (95% CI)	Upper Benchmark: 50th percentile (95% CI)	Lower Benchmark S_{GEN} (95% CI)	Upper Benchmark 80% S_{MSY} (95% CI)
West Vancouver Island	NA	NA	TBA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Haida Gwaii

Table A. 13. Summary statistics, biological status assessments, and benchmarks values for Haida Gwaii Conservation Units (CUs).

Current abundance is expressed as the average over the most recent generation, shown in parentheses. Years of Data shows the number of years over the time series with CU-level estimates of spawner abundance. For the spawner-recruitment metric, the percentage in each column is the probability (%) of a given status based on the benchmarks (SGEN and 80% SMSY) estimated from a Hierarchical Bayesian Model. For the spawner-recruitment benchmark values, 95% credible intervals are shown in parentheses. The percentile benchmark values show 95% confidence intervals in parentheses. The Pacific Salmon Foundation benchmark method and status shown on the Pacific Salmon Explorer for each CU are noted by the highlighted status color.

Conservation Unit	Current Abundance	Years of Data	# of spawner-recruitment pairs	Biological Status						Status Metrics			
				Percentile	Spawner-Recruitment			WSP	COSEWIC	Percentile		Spawner-Recruitment	
					% Chance of Red Status	% Chance of Amber Status	% Chance of Green Status			Lower Benchmark : 25th percentile (95% CI)	Upper Benchmark : 50th percentile (95% CI)	Lower Benchmark S_{GEN} (95% CI)	Upper Benchmark 80% S_{MSY} (95% CI)
Chinook													
North Haida Gwaii	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
East Haida Gwaii	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Conservation Unit	Current Abundance	Years of Data	# of spawner-recruitment pairs	Biological Status						Status Metrics			
				Percentile	Spawner-Recruitment			WSP	COSEWIC	Percentile		Spawner-Recruitment	
					% Chance of Red Status	% Chance of Amber Status	% Chance of Green Status			Lower Benchmark : 25th percentile (95% CI)	Upper Benchmark : 50th percentile (95% CI)	Lower Benchmark S_{GEN} (95% CI)	Upper Benchmark 80% S_{MSY} (95% CI)
Chum													
North Haida Gwaii-Stanley Creek	NA	43	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
East Haida Gwaii	76,908	61	NA		54%	46%	0%	NA	NA	119,299	187,329	79,283 (0-27,003,290)	132,521 (89,350-43,471,169,307)
North Haida Gwaii	6,541	57	NA		100%	0%	0%	NA	NA	18,710	45,353	15,910 (12,181-21,589)	25,431 (19,412-34,490)
West Haida Gwaii	83,409	61	NA		0%	0%	100%	NA	NA	67,871	91,700	32,020 (26,853-41,555)	51,231 (42,964-66,487)
Skidegate	42,417	62	NA		17%	82%	1%	NA	NA	55,950	80,306	36,054 (28,263-56,823)	57,701 (45,294-91,426)

Conservation Unit	Current Abundance	Years of Data	# of spawner-recruitment pairs	Biological Status						Status Metrics			
				Percentile	Spawner-Recruitment			WSP	COSEWIC	Percentile		Spawner-Recruitment	
					% Chance of Red Status	% Chance of Amber Status	% Chance of Green Status			Lower Benchmark : 25th percentile (95% CI)	Upper Benchmark : 50th percentile (95% CI)	Lower Benchmark S_{GEN} (95% CI)	Upper Benchmark 80% S_{MSY} (95% CI)
Coho													
East Haida Gwaii	69,655	64	NA		0%	2%	98%	NA	NA	47,592	66,662	30,012 (23,751-42,673)	48,019 (38,001-68,276)
West Haida Gwaii	25,728	47	NA		0%	2%	98%	NA	NA	13,174	26,976	9,797 (6,762-16,800)	14,465 (8,840-23,873)
Graham Island Lowlands	154,422	57	NA		1%	5%	95%	NA	NA	71,016	110,075	54,471 (30,308-114,642)	87,151 (46,514-183,427)
Pink (odd-year)													
East Haida Gwaii	57,706	30	NA		0%	2%	98%	NA	NA	23,454	49,735	19,441 (12,292-35,526)	29,093 (12,527-56,346)
North Haida Gwaii	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Conservation Unit	Current Abundance	Years of Data	# of spawner-recruitment pairs	Biological Status: Percentile	Biological Status: Spawner-Recruitment: % Chance of Red Status	Biological Status: Spawner-Recruitment: % Chance of Amber Status	Biological Status: Spawner-Recruitment: % Chance of Green Status	Biological Status: WSP	Biological Status: COSEWIC	Status Metrics: Percentile: Lower Benchmark : 25th percentile (95% CI)	Status Metrics: Percentile: Upper Benchmark : 50th percentile (95% CI)	Status Metrics: Spawner-Recruitment: Lower Benchmark S_{GEN} (95% CI)	Status Metrics: Spawner-Recruitment: Upper Benchmark 80% S_{MSY} (95% CI)
West Haida Gwaii	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Pink (even-year)													
North Haida Gwaii	414,318	30	NA		10%	59%	31%	NA	NA	421,770	680,033	291,401 (159,710-537,956)	466,246 (255,554-860,730)
East Haida Gwaii	262,448	31	NA		36%	62%	3%	NA	NA	459,350	756,747	239,498 (162,828-491,358)	383,196 (260,528-786,172)
West Haida Gwaii	3,823	31	NA		100%	0%	0%	NA	NA	150,748	268,038	84,925 (56,763-163,794)	135,883 (90,839-262,070)
Sockeye (lake-type)													
Ain/Skundale / Ian	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Conservation Unit	Current Abundance	Years of Data	# of spawner-recruitment pairs	Biological Status						Status Metrics			
				Percentile	Spawner-Recruitment			WSP	COSEWIC	Percentile		Spawner-Recruitment	
					% Chance of Red Status	% Chance of Amber Status	% Chance of Green Status			Lower Benchmark : 25th percentile (95% CI)	Upper Benchmark : 50th percentile (95% CI)	Lower Benchmark S_{GEN} (95% CI)	Upper Benchmark 80% S_{MSY} (95% CI)
Awun	7,224	58	NA		0%	0%	100%	NA	NA	2,000	4,900	1,398 (887-2,267)	3,004 (2,371-3,985)
Fairfax	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Jalun	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Marian/Eden	9,862	56	NA		6%	13%	81%	NA	NA	3,750	8,000	4,733 (2,648-21,177)	7,501 (4,592-73,355)
Marie	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Mathers	NA	28	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Mercer	6,454	53	NA		1%	1%	99%	NA	NA	4,000	6,000	1,696 (915-3,769)	3,338 (2,641-5,255)

Conservation Unit	Current Abundance	Years of Data	# of spawner-recruitment pairs	Biological Status						Status Metrics			
				Percentile	Spawner-Recruitment			WSP	COSEWIC	Percentile		Spawner-Recruitment	
					% Chance of Red Status	% Chance of Amber Status	% Chance of Green Status			Lower Benchmark : 25th percentile (95% CI)	Upper Benchmark : 50th percentile (95% CI)	Lower Benchmark S_{GEN} (95% CI)	Upper Benchmark 80% S_{MSY} (95% CI)
Skidegate	15,035	63	NA		0%	3%	97%	NA	NA	10,000	18,600	7,092 (5,145-10,970)	10,962 (8,337-15,380)
Yakoun	7,219	59	NA		5%	91%	4%	NA	NA	7,500	15,000	5,353 (3,297-7,940)	8,673 (7,122-11,951)
Sockeye (river-type)													
East Haida Gwaii	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
North Haida Gwaii	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
West Haida Gwaii	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Columbia

Table A. 14. Summary statistics, biological status assessments, and benchmarks values for Columbia Conservation Units.

Current abundance is expressed as the average over the most recent generation, shown in parentheses. Years of Data shows the number of years over the time series with CU-level estimates of spawner abundance. For the spawner-recruitment metric, the percentage in each column is the probability (%) of a given status based on the benchmarks (SGEN and 80% SMSY) estimated from a Hierarchical Bayesian Model. For the spawner-recruitment benchmark values, 95% credible intervals are shown in parentheses. The percentile benchmark values show 95% confidence intervals in parentheses. The Pacific Salmon Foundation benchmark method and status shown on the Pacific Salmon Explorer for each CU are noted by the highlighted status color.

Conservation Unit	Current Abundance	Years of Data	# of spawner-recruitment pairs	Biological Status						Status Metrics			
				Percentile	Spawner-Recruitment			WSP	COSEWIC	Percentile		Spawner-Recruitment	
					% Chance of Red Status	% Chance of Amber Status	% Chance of Green Status			Lower Benchmark : 25th percentile (95% CI)	Upper Benchmark : 50th percentile (95% CI)	Lower Benchmark S_{GEN} (95% CI)	Upper Benchmark 80% S_{MSY} (95% CI)
Chinook													
Okanagan	38	13	NA		NA	NA	NA	NA	NA	NA	NA	NA	NA
Sockeye (lake-type)													
Osoyoos	21,052	60	NA	NA	NA	NA	NA		Endangered	12,099	17,913	NA	NA

Appendix 5: Rules for Defining Zones of Influence

We define ZOIs for the spawning life stage for each salmon CU. A spawning ZOI represents the area of land that drains directly into the spawning habitat of a specific salmon CU.

To spatially define ZOIs, we use the Province of British Columbia's 1:20,000 Freshwater Atlas (FWA) Assessment Watersheds dataset (hereafter, 1:20K FWA assessment watersheds), which is a geospatial dataset freely available online via DataBC. The rules for defining ZOIs were initially developed by the Skeena Technical Advisory Committee (Porter et al. 2013, 2014) with specific nuances that vary by species and life stage.

Spatial processing for all ZOIs has been conducted using ArcGIS Desktop 10.6 using Python scripts, which allow automatic querying of the FWA hierarchical coding systems to identify areas upslope of a given spawning area. For lake-type sockeye CU, this process identifies all of those streams that are directly upslope of spawning lakes and captures them. ZOIs for all species across all regions are manually reviewed, verified, and corrected as needed.

Lake-type Sockeye CU Zones of Influence

Spawning ZOI: For each CU, we identify the lake outlet and define an upstream ZOI by delineating the areas of all 1:20K FWA assessment watersheds that are upstream of the lake outlet. This upstream area captures the area of land which influences spawning sites for lake-type sockeye CUs.

River-type Sockeye CU Zones of Influence

Spawning ZOI: The extent of all 1:20K FWA assessment watersheds that directly intersect with known spawning locations for river-type sockeye.

Chum CU Zones of Influence

Spawning ZOI: The FWA assessment watersheds that intersect directly with known chum spawning locations delineate the spawning ZOI for each chum CU.

Chinook CU Zones of Influence

Methods for delineating Chinook CU spawning zones of influence vary by region in accordance with the CU delineation approach used by DFO. In the Skeena, Nass, Central Coast, and Haida Gwaii Regions, Chinook CUs are defined using a more restrictive geographic representation. In the Fraser, Vancouver Island and Mainland Inlets, and Columbia regions, Chinook CUs are more broadly defined geographically.

Spawning ZOI (Skeena, Nass, Central Coast, and Haida Gwaii Regions): All the FWA assessment watersheds that intersect directly with Chinook CU locations, regardless of whether or not spawning locations were identified for Chinook within an assessment watershed.

Spawning ZOI (Fraser, VIMI, and Columbia Regions): Defined by the full extent of the 1:20K FWA assessment watersheds that directly intersect with identified spawning locations for each Chinook CU. In the Columbia region, assessment watersheds that contained spawning locations upstream of the CU boundary were included as part of the CU's spawning ZOI.

Coho CU Zones of Influence

Spawning ZOI: Defined by the full extent of the 1:20K FWA assessment watersheds that directly intersect with identified spawning locations for each coho CU.

Pink CU Zones of Influence

Spawning ZOI: Defined by the full extent of the 1:20K FWA assessment watersheds that directly intersect with identified spawning locations for each pink salmon CU.

Appendix 6: Description of Habitat Pressure Indicators & Relevance to Salmon

Table A. 15. Habitat pressure indicators, associated metrics, relevance to salmon habitat, and limitations.

Indicator	Metric	Description	Rationale	Limitations
Total Land Cover Alteration	% watershed area	The percentage of the total watershed area that has been altered by human activity. A sum of forest disturbance, urban land use, agricultural/rural land use, mining development, and other development.	Represents potential changes in cumulative watershed processes, such as hydrologic flows and sediment generation, that can affect spawning and rearing habitats downstream (Poff et al. 2006, in Stalberg et al. 2009).	The data currency and completeness varies for the data sources included in this indicator. Specifically, the land cover classification dataset is current only to 2005 (1996-2005).
Mining Development	# of mines	The number of active and past-producing coal, mineral, or aggregate (gravel) mine sites within a watershed.	Mining development can affect or potentially cause the loss of salmon habitat, through the actual footprint of the mine itself, any tailings ponds, other infrastructure development, or indirectly through the disruption of stream beds and input of fine sediment or other contaminants (Meehan 1991, Nelson et al. 1991, Kondolf 1997).	The aggregate mining dataset was last updated in 2004. Data on the actual footprints of mine sites and other infrastructure development is not readily available at the watershed scale. Impacts of mines are therefore assessed in a binary (presence/absence) manner.
Impervious Surfaces	% watershed area	The percentage of the total watershed area that is represented by hard, impervious surfaces (e.g. paved).	This indicator reflects the number of built structures (e.g. paved roads, sidewalks, buildings, etc.) that are covered by impervious surfaces (e.g. concrete, asphalt, brick, etc.). Extensive impervious surfaces in a watershed can alter and affect natural hydrologic flow patterns and lead to stream degradation through changes in geomorphology and hydrology, and can also lead to increased nutrient loading and contaminant loads downstream (Rosenau and Angelo 2009). The concentration of impervious surfaces in the built environment and the relative irreversibility of this disturbance means that the impact on habitat quality is	Patterns of urban/rural development may be overestimated in some Regions (e.g. Central Coast) as the Impervious Surface Coefficients (ISCs) for land types used in this analysis were developed for watersheds in Connecticut (Prisloe et al. 2003) with higher population densities (>500 but <1800 people/square mile).

Indicator	Metric	Description	Rationale	Limitations
			typically very high (Schendel et al. 2004; Schindler et al. 2006; Smith et al. 2007; Jokinen et al. 2010; Paul and Meyer 2001 in Nelitz et al. 2011; Cooke et al. 2020.	
Linear Development	km/km^2	The density of all linear developments within a watershed, including roads, railways, utility corridors, pipelines, power lines, telecom cables, right of ways, etc.	Linear development gives an indication of the overall level of development from resource activities that may affect salmon habitats (WCEL 2011, FLNRORD et al. 2012).	See *Road Development*
Forest Disturbance	% watershed area	The percentage of total watershed area that has been disturbed by logging and burning in the last 60 years.	Logging and other disturbances that reduce forest cover can change watershed hydrology by affecting rainfall interception, transpiration, and snowmelt processes, which may affect salmon habitats through altered peak flows, low flows, and annual water yields (MOF 1995, Smith and Redding 2012).	Datasets may be limited by private land ownership in some Regions, which may result in an underestimate of Forest Disturbance. The temporal cutoff of 60 years may be inappropriate in some cases (e.g. highly developed urban areas, or watersheds with slower regeneration patterns such as snow-dominated biogeoclimatic zones).
Equivalent Clearcut Area (ECA)	% watershed area	The percentage of total watershed area that is considered comparable to a clearcut forest. ECA represents the cumulative effect of harvesting and second-growth forests on the hydrological cycle.	A derived metric of forest disturbance, ECA reflects the pressure on salmon habitat mainly from potential increases in peak flow (MOF 2001; Smith and Redding 2012).	Calculating ECA relies on projected tree height data that is not always available in the data sources; if not available, we assume tree height to be zero. Total Land Cover Alteration limitations also apply here due to overlapping data inputs.
Riparian Disturbance	% watershed area	The percentage of the total watershed area that has been altered by human activity (forest disturbance, urban land use, agricultural/rural land use, mining development, and other development) within a 30m buffer zone around all streams, rivers, lakes, and wetlands.	Disturbance to riparian areas can affect salmon habitats by destabilizing stream banks, increasing surface erosion and sedimentation, reducing nutrient and woody debris inputs to water bodies, and increasing stream temperatures if streamside shading is reduced (Meehan 1991, MOF 1995). These impacts have the potential to affect the growth and survival	The data currency and completeness vary for the data sources included in this indicator. Specifically, the land cover classification dataset is current only to 2005 (1996-2005).

Indicator	Metric	Description	Rationale	Limitations
			of salmon eggs and juvenile salmon.	
Insect and Disease Defoliation	% watershed area	The percentage of pine forests that have been killed by insects or disease.	Forest defoliation from insects or diseases can reduce precipitation interception, reduce transpiration, and lead to increased soil moisture. The resulting changes to peak flows and groundwater supplies can affect salmon habitats (Bustanul. 2006, EDI 2008 in Nelitz et al. 2011). The hydrological processes in forest stands affected by insects and disease can take 20-60 years to recover (FPB 2007). If salvage logged, these stands will have the same watershed effects as clear cut logging.	These data are derived from a model and aerial surveys current to 2010.
Road Development	km/km^2	The average density of all roads within a watershed	Road development can interrupt sub-surface flow, increase peak flows, and interfere with natural patterns of overland water flow in a watershed (Smith and Redding 2012). Road construction can cause significant erosion by exposing large areas of soil to rain and snow, and roads intercept and amplify surface runoff, leading to increased erosion downslope (MOF 1995). These eroded fine sediments can flush into water bodies, affecting salmon spawning habitats by covering redds, reducing oxygenation of incubating eggs, and increasing turbidity which can lead to reduced foraging success of juveniles (Meehan 1991).	Data is an amalgamation of the Digital Roads Atlas (DRA) and Forest Tenure Road segments that occur outside a 30m buffer of all DRA roads.
Stream Crossing Density	#/km	The total number of stream crossings per km of the total length of modelled salmon habitat in a watershed. Salmon habitat is defined based on a gradient criterion filtering of the Fish	Stream crossings can create problems for fish passage by interfering with or blocking access to upstream spawning or rearing habitats, thus decreasing the total amount of available salmon habitat (Harper and Quigley 2000,	This indicator is based on modelled data determining salmon habitat that is gradient-based, along with the presence of stream crossings which are modelled at the intersection of roads and streams.

Indicator	Metric	Description	Rationale	Limitations
		Passage Model (Mount et al. 2011).	FLNRO et al. 2012. Stream crossings can also affect water delivery to the stream network, causing increased peak flows, and become a source of fine sediment delivery to streams (MOF 1995; Smith & Redding 2012).	Stream crossings have not been confirmed nor assessed for actual fish passage.
Water Licenses	# of permitted water licenses	The total number of water licences permitted for water withdrawal for domestic, industrial, agricultural, power, and storage uses from points of diversion within a watershed. This indicator is evaluated within watersheds for all salmon CUs. For lake-type sockeye CUs, the number of water licenses is also summed across the full extent of all watersheds in each CU migration ZOI to capture the potential combined effect of water extraction on mainstem water levels along the migration routes of lake-type sockeye.	Heavy allocation and use of both surface and subsurface water for human use can affect salmon habitat by reducing instream flow to levels that could, at critical times of the year, limit physical access to spawning and rearing habitats, or potentially expose redds. Reductions in both surface and subsurface water supply can also lead to increased water temperatures, which can impact salmon at all life stages (Richter et al. 2003 and Hatfield et al. 2003 in Stalberg et al. 2009; Douglas 2006).	Water license data represents water allocation only, not actual water use, as monitoring and compliance of water licences do not occur consistently. Water license data also does not account for temporary water permits obtained for short term use.
Waste Water Discharges	# of permitted waste water discharges	The number of permitted waste water management discharge sites within a watershed.	Waste water discharge can impact water quality in salmon habitats through either chemical contamination, which can directly injure or kill aquatic life (US EPA 2008), or excessive nutrient enrichment (eutrophication), which can result in dissolved oxygen depletion in water bodies and suffocate aquatic organisms (Zheng and Paul 2007).	This dataset only identifies permitted waste water discharge sites. Calculating the actual risk and impact to salmon habitats requires data on the volume and nature of waste water discharge.

Appendix 7: Habitat Pressure Datasets & Data Sources

Table A. 16. Habitat pressure datasets, data sources, and dataset publication years.

Dataset Name	Source	Date of Data						
		Skeena	Nass	Central Coast	Fraser	Vancouver Island & Mainland Inlets	Haida Gwaii	Columbia
Aggregate Mining Inventory	BC EMPR	2004	2004	2004	2004	2004	2004	2004
Base Thematic Mapping (mining polygons)	DataBC	1992	1992	1992	1992	1992	1992	1992
BC Freshwater Atlas Assessment Watershed Polygons	DataBC	2008	2012	2016	2016	2016	2021	2021
BC Freshwater Atlas Lake Polygons	DataBC	2008	2012	2016	2016	2016	2016	2016
BC Freshwater Atlas River Polygons	DataBC	2008	2012	2016	2016	2016	2016	2016
BC Freshwater Atlas Stream Network	DataBC	2008	2012	2016	2016	2016	2016	2016
BC Freshwater Atlas Watershed Groups Polygons	DataBC	2008	2012	2016	2016	2016	2016	2016
BC Freshwater Atlas Wetland Polygons	DataBC	2008	2012	2016	2016	2016	2016	2016
BC MOE Fish Passage Habitat Model	BC MOECCS	2011	2011	2017	2017	2017	2017	2017
BC Points of Diversion (POD) with Water License Information	DataBC	2012	2016	2017	2018	2018	n/a	n/a
Water Licenses Licences - Public	DataBC	n/a	n/a	n/a	n/a	n/a	2021	2021
BC Watershed Atlas Major Watershed Polygons	DataBC	2008	2008	2008	2008	2008	2008	2008

Dataset Name	Source	Date of Data						
		Skeena	Nass	Central Coast	Fraser	Vancouver Island & Mainland Inlets	Haida Gwaii	Columbia
CanVec Railways	Natural Resources Canada	1998	1998	1998	1998	1998	1998	1998
CanVec Trails	Natural Resources Canada	1998	1998	1998	1998	1998	1998	1998
Coal and Mineral Mines (Minfile)	BC EMPR	2012	2012	2017	2018	2018	n/a	n/a
MINFILE Inventory Database	DataBC	n/a	n/a	n/a	n/a	n/a	2021	2021
Conservation Unit Boundaries	DFO	2008	2008	2008	2017; SEL & CK 2019	2017; SEL & CK 2019	2017; SEL & CK 2019	2021
Crown Tenures (Utility Corridors and Rights of Ways)	DataBC	2012	2016	2017	2018	2018	2021	2021
Crown Tenures (Wind and Water Power)	DataBC	2012	2016	2017	2018	2018	2021	2021
Current Fire Perimeters	DataBC	2012	2012	2017	2018	2018	2021	2021
Digital Road Atlas (DRA)	DataBC	2012	2016	2017	2018	2018	n/a	n/a
Forest Tenure Cutblocks	DataBC	2012	2016	2016	2018	2018	n/a	n/a
Forest Tenure Road Segments (FTEN)	DataBC	2012	2016	2017	2018	2018	n/a	n/a
Integrated Roads	BC CEF	n/a	n/a	n/a	n/a	n/a	2021	2021
Harvested Areas of BC (consolidated cutblocks)	DataBC	n/a	n/a	2015	2018	2018	n/a	2021
Logging History on Haida Gwaii 1962 to 2021	Gowgaia Institute	n/a	n/a	n/a	n/a	n/a	2021	n/a

Dataset Name	Source	Date of Data						
		Skeena	Nass	Central Coast	Fraser	Vancouver Island & Mainland Inlets	Haida Gwaii	Columbia
Historical Fire Perimeters	DataBC	2012	2012	2017	2018	2018	2021	2021
Known BC Fish Observations and BC Fish Distributions (FISS)	DataBC	2012	2016	2016	2018	2018	2021	2021
Human Disturbance with Base Thematic Mapping	BC CEF	n/a	n/a	n/a	n/a	n/a	2021	2021
Landcover circa 2000 (agriculture, urban)	Natural Resources Canada	2000	2000	2000	2000	2000	2000	2000
MOE Waste Water Discharge and Permits Database	BC MOECCS	2012	2016	2016	2018	2018	2021	2021
OGC Pipeline Rights-of-Way	DataBC	2012	2016	2017	2018	2018	n/a	n/a
Pipelines: Coastal GasLink Pipeline (proposed)	Johanna Pfalz (Eclipse GIS)	2014	2014	2014	n/a	n/a	n/a	n/a
Pipelines: Oil and Gas Commission Pipeline Segment Permits	DataBC	n/a	n/a	n/a	2020	2020	n/a	2021
Pipelines: Pacific Northern Gas (existing)	Johanna Pfalz (Eclipse GIS)	2014	2014	2014	n/a	n/a	n/a	n/a
Pipelines: Pacific Northern Gas Looping Project (proposed)	Johanna Pfalz (Eclipse GIS)	2014	2014	2014	n/a	n/a	n/a	n/a
Pipelines: Pacific Trails Pipeline (proposed)	Johanna Pfalz (Eclipse GIS)	2014	2014	2014	n/a	n/a	n/a	n/a
Pipelines: Prince Rupert Gas Transmission Project (proposed)	Chartwell Consultants Ltd.	2016	2016	2016	n/a	n/a	n/a	n/a
Pipelines: Trans Mountain Expansion Project	Digitized by PSF from TransMountain map	n/a	n/a	n/a	2020	2020	n/a	n/a

Dataset Name	Source	Date of Data						
		Skeena	Nass	Central Coast	Fraser	Vancouver Island & Mainland Inlets	Haida Gwaii	Columbia
Pipelines: West Coast Connector Gas Transmission Project (proposed)	Chartwell Consultants Ltd.	2016	2016	2016	n/a	n/a	n/a	n/a
Placer Tenures	DataBC	2012	2012	2016	2018	2018	2021	2021
Power Lines: Expert knowledge (Skeena TAC) BC Hydro NW Transmission Line (BC Hydro) CanVec Power Lines (Natural Resources Canada) BC Transmission Lines (DataBC)	◊ Skeena TAC □ BC Hydro (digitized by PSF) * Natural Resources Canada ± DataBC	1998 * 2010 ◊	1998 * 2014 □	1998 * 2014 □	1998 * 2020 ±	1998 * 2020 ±	n/a	n/a
Reporting Silviculture Updates and Land Status Tracking System (RESULTS)	DataBC	2012	2016	2017	2018	2018	n/a	n/a
Spawning Distribution (local experts)	Technical Advisory Committees	2012	2015	2016	2019	2019	2021	2021
Spawning Distribution (stream survey reports)	Raincoast Conservation Foundation for the Heiltsuk Nation	n/a	n/a	2016	n/a	n/a	n/a	n/a
Stream Survey Locations (NuSEDs)	DFO	2012	2015	2014	2018	2018	2021	2021
Timber Harvesting Land Base	BC FLNRORD	2015	2015	2017	2017	2017	2021	2021
Vegetation Resources Inventory (VRI)	DataBC	2012	2012	2016	2018	2018	2020	2020

Appendix 8: Spatial Data Processing for Habitat Pressure Indicators

Table A. 17. Spatial Data Processing for Habitat Pressure Indicators.

Impact Category	Indicator	Units	Definition	Data Source	Dataset(s)	Processing	Notes
Human Development Footprint	Total Land Cover Alteration	% watershed area	The percentage of the total watershed area that has been altered by human activity.	DataBC	Harvested Areas of BC (Consolidated Cutblocks) Vegetation Resources Inventory (VRI) Digital Road Atlas (DRA) Forest Tenure Road Segments (FTEN) Crown Tenures (Utility Corridors and Rights of Ways)	Agriculture land cover was extracted from the LCC2000-V. Urban land cover was extracted from the LCC2000-V and merged with urban polygons extracted from the VRI. Forestry polygons were extracted from the Consolidated Cutblocks layer. Areas where logging had occurred greater than 60 years ago were not considered. The linear road features from the road development indicator were buffered by their corresponding road width, calculated as (number of lanes) × (8 m for freeways/highways or 5 m for everything else). Where the number of lanes attribute was not known (i.e. FTEN roads), the road was assumed to be 1 lane. Rail linear features were buffered by 4 m	Road datasets may have incomplete coverage in some Regions. Some the datasets used to produce the Total Land Cover Alteration indicator are outdated: mining polygons from the base thematic mapping product (early 1990s), agriculture and urban polygons from Landcover (circa 2000), railways from CanVec (circa 1998).

Impact Category	Indicator	Units	Definition	Data Source	Dataset(s)	Processing	Notes
					Historical Fire Perimeters Current Fire Perimeters Base Thematic Mapping	per track. Agriculture, urban, forestry, road, and rail polygons were merged with the crown tenure utility corridor/ROW polygons, fire polygons (areas burnt within the last 25 years), and mining area polygons. The resulting land cover layer was planarized; where different land cover class polygons overlapped, the following priority order was used to determine the land cover class of the overlapping area (highest priority first): road, rail, utility, forestry, urban, mine, fire, agriculture. The final land cover class layer was overlaid with the watersheds. Total altered land area for any watershed is a sum of all land cover polygons in that watershed.	
				Geogratis	Landcover (circa 2000) CanVec		
	Mining Development	# of mines	The number of active and past-producing coal, mineral, or aggregate (gravel) mine sites within a watershed.	BC Ministry of Energy, Mines, and Petroleum Resources DataBC	Aggregate Inventory MINFILE Placer tenures	Past producing and producing mineral and coal mines were extracted from MINFILE and combined with aggregate mines. Placer mine tenure polygons were converted to point features (centre point) with one point per unique placer mine. These mine locations were then overlaid with the watersheds layer and the total number of mines were calculated for each watershed.	Aggregate mining data is outdated (2004) and may not represent the best available data.

Impact Category	Indicator	Units	Definition	Data Source	Dataset(s)	Processing	Notes
	Impervious Surfaces	% watershed area	The percentage of the total watershed area that is represented by hard, impervious surfaces (e.g. paved).	DataBC Geogratis	Vegetation Resources Inventory (VRI) Digital Road Atlas (DRA) Forest Tenure Road Segments (FTEN) CanVec Landcover (circa 2000; agriculture & urban)	Urban, road, rail, and agriculture polygons were combined (union process) and overlaid with the watersheds layer. An impervious surfaces coefficient (ISC) attribute was added to each polygon, representing the proportional area of that land cover that can be considered impervious. ISC values were calculated using the average ISC for land cover categories as defined by Prisloe et al. 2003, for medium population density areas (>= 500 but < 1800 people/square mile). The following ISC values were applied to each area of each polygon: urban (0.19878), agriculture (0.0719), roads (1.0), rail (1.0). All ISC adjusted polygon areas were then summed to give the total impervious surface area for each watershed.	Railway data from CanVec (1998) and the agriculture and urban polygons from Landcover (2000) are outdated and may not represent the best available data.
	Linear Development	km/km^2	The density of all linear developments within a watershed, including roads, railways, utility	DataBC	Digital Road Atlas (DRA) Forest Tenure Road Segments	Roads, pipelines, power lines, trails, and railway lines were combined into one linear feature layer, which was overlaid with the watersheds layer. The sum of the line length was calculated for each watershed. This length was then divided by the total watershed area to give a linear feature	Road datasets may have incomplete coverage in some Regions. Power line, trail, and railway data from the

Impact Category	Indicator	Units	Definition	Data Source	Dataset(s)	Processing	Notes
			corridors, pipelines, power lines, telecom cables, right of ways, etc.	Geogratis Eclipse GIS	(FTEN) CanVec Pacific Northwest Gas Existing Line	density for each watershed.	CanVec dataset is outdated (1998) and may not represent the best available data.
Hydrologic Processes	Forest Disturbance	% of watershed	The percentage of total watershed area that has been disturbed by logging and burning in the last 60 years.	DataBC	Harvested Areas of BC (Consolidated Cutblocks)	Forestry polygons were overlaid with the watersheds layer to calculate total forested area per watershed.	Forestry polygons were prepared as part of the total landcover alteration (TLCA) indicator. See TCLA for processing details.
	Equivalent Clearcut Area (ECA)	% of watershed	The percentage of total watershed area that is considered comparable to a clearcut forest.	BC Ministry of Forests, Lands, Natural Resource Operations, and Rural Development (FLNRORD)	The proportion of opening covered by functional regeneration and recovery factor determined by projected canopy height. Urban, road, rail, utility, and forest	All urban, road, rail, and utility polygons were merged and dissolved into a single layer and overlaid with the watersheds layer. Forestry polygons were combined (union process) with this new layer. The growth recovery of each forested/alienated polygon was calculated using the following equation:	This indicator is partially derived from the total land cover alteration dataset. See total land cover alteration indicator for processing details to prepare urban, road, rail, utility, and forestry polygons. An update to MOF's ECA

Impact Category	Indicator	Units	Definition	Data Source	Dataset(s)	Processing	Notes
				See Total Land Cover Alteration indicator for additional data sources	polygons	ECA = A*C(1-R/100) where A is the original polygon area, C is the proportion of the opening covered by functional regeneration (determined from Table A2.1, MOF 2001), and Table A2.2 (MOF 2001). For developed polygons, there is no functional regeneration or recovery factor, so for these polygons C will be equal to 1 and R will be equal to 0. Forestry polygons with no tree height information were assumed to have a height of 0m. All ECA values were summed for each watershed and divided by the total watershed area to give an ECA percentage.	protocol is currently in draft but has not yet been applied to the PSE.
Vegetation Quality	Riparian Disturbance	% watershed area	The percentage of the riparian area that has been altered by human activity (forest disturbance, urban land use, agricultural/rural land use, mining	DataBC	Freshwater Atlas: Stream network, lakes, wetlands. Total Land Cover Alteration restricted to the riparian zone (30m buffer around all water	A layer representing the riparian zone (30m buffer around streams and water bodies) was created for each Region. Stream features were buffered by 30m (including only ditch and canal features that intersected the streams). An overlay (identity process) was performed using the buffered stream features and watershed layer. The resulting layer was dissolved by	This indicator is derived from the total land cover alteration indicator, see total land cover alteration for processing details.

Impact Category	Indicator	Units	Definition	Data Source	Dataset(s)	Processing	Notes
			development, and other development).		bodies).	watershed ID. Lake and wetland features were merged into one layer and buffered by 30m (isolated lakes and wetlands away from the stream network were not included). Buffer features resulting from islands or donuts in the water bodies were removed. Prior to buffering lakes and wetlands, all features in those layers coincident with stream arcs FTRCD WA24111170 (isolated water bodies) were selected and extracted. These extracted isolated water bodies were overlaid with the stream network, and features intersecting the streams were selected and added to the water body layer for buffering in case a water body was incorrectly tagged as 'isolated' in the dataset. An overlay (identity process) was performed using the buffered water body features and the watershed layer. The resulting layer was dissolved by watershed ID. River features were buffered by 30m. Buffer features around islands or donuts were also	

Impact Category	Indicator	Units	Definition	Data Source	Dataset(s)	Processing	Notes
						removed. An overlay (identity process) was performed using the buffered river features and the watershed layer. The resulting layer was dissolved by watershed ID. The buffer layers for streams, water bodies, and rivers were merged into one layer and dissolved by watershed ID. The resulting layer was overlaid (identity process) with the total land cover alteration layer. Riparian disturbance was summarized by area (in hectares) and percentage of total riparian area per watershed.	
	Insect and Disease Defoliation	% watershed area	The percentage of pine forests that have been killed by insects or disease.	DataBC	Vegetation Resources Inventory (VRI)	VRI was overlaid (identity process) with the watersheds layer. VRI polygons for dead and live stand volumes were summarized by watershed, using the maximum value in the 3 dead/live volume utility levels for each stand. Percentage of the forest stand killed was calculated as: (sum of dead stand volume)/(sum of dead stand volume + sum of live stand volume)	Conversion of live standing volume to dead volume in the VRI follows predictions made using the provincial MPB model and the 2010 aerial overview surveys.

Impact Category	Indicator	Units	Definition	Data Source	Dataset(s)	Processing	Notes
Surface Erosion	Road Development	km/km^2	The average density of all roads within a watershed	Data BC	Digital Road Atlas (DRA) - Master Partially-Attributed Roads Forest Tenure Road Segments (FTEN)	Roads were clipped using the watershed layer. FTEN road segments that do not appear in the DRA were extracted from FTEN by applying a 30m buffer to DRA roads and selecting all FTEN roads outside of this buffer. The extracted FTEN roads were merged with the original DRA roads to produce a single comprehensive road layer. The road data were overlaid (identity process) with watersheds. Road length was summarized by watershed and divided by watershed area to calculate road density per watershed (km/km^2).	DRA and FTEN roads contain representations of the same roads but do not have identical geometries. The process of buffering the DRA to identify additional FTEN roads that do not appear in the DRA was a solution to produce a single road layer with minimal duplication. However, the resulting road layer is not topographically correct and should not be used as such.
Fish Passage/ **Habitat Connectivity**	Stream Crossing Density	# crossings/km of salmon accessible stream	The total number of stream crossings per km of the total length of modeled salmon habitat in a watershed.	BC Ministry of Environment and Climate Change Strategy	BC MOE Fish Habitat Model	Fish habitat arc and stream crossing points classified as 15% or less gradient were overlaid with the watersheds layer. Inferred and observed fish habitat was merged into a single 'fish habitat' group. A total number of fish habitat crossings per total length of fish habitat was calculated for each watershed.	Note, the fish habitat and stream crossings data are based on modeled data. For more information on the accessible stream length input data, contact Craig Mount, BC Ministry of Environment and Climate Change Strategy.
Water Quantity	Water Licenses	# of permitted water	The total number of water licences permitted for	DataBC	BC Points of Diversion (POD) with Water License	POD features were clipped using watersheds. Only current water licenses were used. Clipped point data were overlaid with watershed using the 'identity' process.	

Impact Category	Indicator	Units	Definition	Data Source	Dataset(s)	Processing	Notes
		licenses	water withdrawal for domestic, industrial, agricultural, power, and storage uses from points of diversion within a watershed.		Information	The total number of POD locations was summarized by watershed. Licenses were also classified into classes: power, domestic, agriculture, industrial, or storage using the PURPOSE attribute.	
Water Quality	Waste Water Discharges	# of permitted waste water discharges	The number of permitted waste water management discharge sites within a watershed.	BC Ministry of Environment and Climate Change Strategy	Waste Water Discharge and Permits database	Active effluent waste water discharge locations, converted to spatial point features, were overlaid with the watersheds layer. The total number of discharge locations was summarized by watershed.	Type of discharge and amount are not currently tracked or incorporated in the analysis.

Table A. 18. Spatial Data Processing for Habitat Pressure Indicators applied in Haida Gwaii. Working with the Gowgaia Institute, we were able to apply additional and updated datasets unique to Haida Gwaii, to support more accurate habitat assessments for some of the key habitat indicators.

Impact Category	Indicator	Units	Definition	Data Source	Dataset(s)	Processing	Notes
Human Development Footprint	Total Land Cover Alteration	% watershed area	The percentage of the total watershed area that has been altered by human activity.	BC Cumulative Effects Framework DataBC	Human Disturbance with Base Thematic Mapping Integrated Roads Historical Fire Perimeters Current Fire Perimeters	Disturbance polygons were extracted from BC CEF's Human Disturbance with Base Thematic Mapping dataset for: mountain pine beetle (not present on Haida Gwaii), railway and airports, recreation, transmission lines, major rights of ways, mining, oil & gas infrastructure, seismic infrastructure (not present on Haida Gwaii), agriculture and urban areas Harvested area polygons were extracted from the Gowgaia's Logging History on Haida Gwaii 1962 to 2021 layer. Areas where logging had occurred greater than 60 years ago were not considered. The linear road features from the road development indicator (sourced from BC CEF's Integrated Roads dataset) were buffered by their corresponding road width, calculated as (number of lanes) × (8 m for freeways/highways or 5 m for everything else). Where the number of lanes attribute was not known (i.e. forest roads), the road was assumed to be 1	The land cover alteration layer is used as an input to the riparian disturbance, impervious surfaces, and ECA indicators.

Impact Category	Indicator	Units	Definition	Data Source	Dataset(s)	Processing	Notes
				Gowgaia Institute	Logging History on Haida Gwaii 1962 to 2021	lane. Burned area polygons were selected from the Current and Historical Fire Perimeters datasets (fires in the last 20 years were selected). All disturbance polygons were combined and planarized; where different disturbances type polygons overlapped, the following priority order was used to determine the disturbance category of the overlapping area (highest priority first): road, mining, rail, oil & gas infrastructure, power, right of way, urban, recreation, oil and gas geophysical (not present on Haida Gwaii), forestry, fire, agriculture. The land cover alteration layer was overlaid with the watersheds. Total altered land area for any watershed is a sum of all land cover polygons in that watershed.	
	Mining Development	# of mines	The number of active and past-producing coal, mineral, or aggregate	BC Ministry of Energy, Mines, and Petroleum Resources	Aggregate Inventory	Past producing and producing mineral and coal mines were extracted from MINFILE and combined with aggregate mines. Placer mine tenure polygons were converted to point features (centre point) with one point per unique placer mine.	Aggregate mining data is outdated (2004) and may not represent the best available data.

Impact Category	Indicator	Units	Definition	Data Source	Dataset(s)	Processing	Notes
			(gravel) mine sites within a watershed.	DataBC	MINFILE Placer tenures	These mine locations were then overlaid with the watersheds layer and the total number of mines were calculated for each watershed.	
	Impervious Surfaces	% watershed area	The percentage of the total watershed area that is represented by hard, impervious surfaces (e.g. paved).	See Total Land Cover Alteration indicator for data sources	Urban, road, rail, and agriculture polygons	Urban, road, rail, and agriculture polygons were combined (union process) and overlaid with the watersheds layer. An impervious surfaces coefficient (ISC) attribute was added to each polygon, representing the proportional area of that land cover that can be considered impervious. ISC values were calculated using the average ISC for land cover categories as defined by Prisloe et al. 2003, for medium population density areas (>= 500 but < 1800 people/square mile). The following ISC values were applied to each area of each polygon: urban (0.19878), agriculture (0.0719), roads (1.0), rail (1.0). All ISC adjusted polygon areas were then summed to give the total impervious surface area for each watershed.	

Impact Category	Indicator	Units	Definition	Data Source	Dataset(s)	Processing	Notes
	Linear Development	km/km^2	The density of linear developments within a watershed	BC Cumulative Effects Framework Geogratis	Integrated Roads CanVec	Roads, pipelines (not present on Haida Gwaii), power lines, trails, and railway lines were combined into one linear feature layer, which was overlaid with the watersheds layer. The sum of the line length was calculated for each watershed. This length was then divided by the total watershed area to give a linear feature density for each watershed.	See the road development indicator for notes that apply here also. Power line, trail, and railway data from the CanVec dataset is outdated (1998) and may not represent the best available data.
Hydrologic Processes	Forest Disturbance	% of watershed	The percentage of total watershed area that has been disturbed by logging and burning in the last 60 years.	Gowgaia Institute DataBC	Logging History on Haida Gwaii 1962 to 2021 Current Fire Perimeters Historical Fire Perimeters	Forestry polygons were filtered to harvest within the last 60 years. Fire polygons were filtered to fires within the last 20 years. Harvested and burned area polygons were overlaid with the watersheds layer to calculate total forested area per watershed.	
	Equivalent Clearcut Area (ECA)	% of watershed	The percentage of total watershed	DataBC	Vegetation Resources Inventory	Disturbance polygons were selected from the total land cover alteration dataset and categorized as recoverable (harvested areas, burned areas, and areas impacted	BC Cumulative Effects Framework (BC CEF) ECA method includes an additional step to approximate stand

Impact Category	Indicator	Units	Definition	Data Source	Dataset(s)	Processing	Notes
			area that is considered comparable to a clearcut forest.	See Total Land Cover Alteration indicator for additional data sources	(VRI) Disturbance polygons	by mountain pine beetle (not present on Haida Gwaii)) and non-recoverable (railway and airports, transmission lines, major rights of ways, mining, oil & gas infrastructure, seismic infrastructure (not present on Haida Gwaii), agriculture and urban areas). A "non-recoverable" layer was created by first merging and dissolving all non-recoverable disturbance types. Harvested and burned area polygons were dissolved based on projected stand height and then merged with the non-recoverable layer. Lastly, harvested area and burned area polygons without stand height but with a date of disturbance were dissolved based on time since disturbance (years) and merged with the non-recoverable and recoverable polygons with stand height. This combined ECA layer was overlaid with the FWA assessment watersheds. The growth recovery of each polygon was calculated based on stand height using the coastal recovery curve or using a time since disturbance surrogate method where stand height information was not readily available. The growth recovery of each recoverable polygon with stand height	height where not available in VRI before defaulting to this time since disturbance surrogate ECA estimate. This data was not available to us at the time of our assessments but our upcoming work to revise our habitat indicator methods will aim to source ECA directly from BC CEF or to update our methods to fill stand height data gaps where possible.

Impact Category	Indicator	Units	Definition	Data Source	Dataset(s)	Processing	Notes
						information was calculated using the following equation: ECA = A*C(1-R/100) where A is the original polygon area, C is the proportion of the opening covered by functional regeneration (determined from Table A2.1, MOF 2001), and R is the recovery factor (for coastal forests from Hudson, R., and G. Horel. 2007 and from Winkler, R., and S. Boon. 2015 for interior forests). For non-recoverable polygons, there is no functional regeneration or recovery factor, so for these polygons C will be equal to 1 and R will be equal to 0. Where stand height is not available (e.g. for harvested areas sourced from Gowgaia Institute) a time since disturbance surrogate was used to estimate ECA: 1-10 yrs = 100% ECA, 11-20 = 75%, 21-40 = 25% and 40-50 yrs = 5%, >50 years = 0%. The ECA layer was overlaid with the watersheds. ECA was summed for each FWA watershed then divided by the total watershed area to give an ECA percentage for each watershed.	

Impact Category	Indicator	Units	Definition	Data Source	Dataset(s)	Processing	Notes
Vegetation Quality	Riparian Disturbance	% watershed area	The percentage of the riparian area that has been altered by human activity (forest disturbance, urban land use, agricultural/ rural land use, mining development, and other development).	DataBC	Freshwater Atlas: Stream network, lakes, wetlands. Total Land Cover Alteration restricted to the riparian zone (30m buffer around all water bodies).	A layer representing the riparian zone (30m buffer around streams and water bodies) was created for each Region. Stream features were buffered by 30m (including only ditch and canal features that intersected the streams). An overlay (identity process) was performed using the buffered stream features and watershed layer. The resulting layer was dissolved by watershed ID. Lake and wetland features were merged into one layer and buffered by 30m (isolated lakes and wetlands away from the stream network were not included). Buffer features resulting from islands or donuts in the water bodies were removed. Prior to buffering lakes and wetlands, all features in those layers coincident with stream arcs FTRCD WA24111170 (isolated water bodies) were selected and extracted. These extracted isolated water bodies were overlaid with the stream network, and features intersecting the streams were selected and added to the water body layer for buffering in case a water body was incorrectly tagged as	This indicator is derived from the total land cover alteration indicator, see total land cover alteration for processing details.

Impact Category	Indicator	Units	Definition	Data Source	Dataset(s)	Processing	Notes
						‘isolated’ in the dataset. An overlay (identity process) was performed using the buffered water body features and the watershed layer. The resulting layer was dissolved by watershed ID. River features were buffered by 30m. Buffer features around islands or donuts were also removed. An overlay (identity process) was performed using the buffered river features and the watershed layer. The resulting layer was dissolved by watershed ID. The buffer layers for streams, water bodies, and rivers were merged into one layer and dissolved by watershed ID. The resulting layer was overlaid (identity process) with the total land cover alteration layer. Riparian disturbance was summarized by area (in hectares) and percentage of total	

Impact Category	Indicator	Units	Definition	Data Source	Dataset(s)	Processing	Notes
						riparian area per watershed.	
	Insect and Disease Defoliation	% watershed area	The percentage of pine forests that have been killed by insects or disease.	DataBC	Vegetation Resources Inventory (VRI)	VRI was overlaid (identity process) with the watersheds layer. VRI polygons for dead and live stand volumes were summarized by watershed, using the maximum value in the 3 dead/live volume utility levels for each stand. Percentage of the forest stand killed was calculated as: (sum of dead stand volume)/(sum of dead stand volume + sum of live stand volume)	Conversion of live standing volume to dead volume in the VRI follows predictions made using the provincial MPB model and the 2010 aerial overview surveys.
Surface Erosion	Road Development	km/km^2	The average density of all roads within a watershed	BC Cumulative Effects Framework	Integrated Roads	Roads were clipped to the region boundary. DRA roads were selected (BCGW_SOURCE = 'WHSE_BASEMAPPING.TRANSPORT_LINE') and buffered by 30m. Non-DRA roads (forest roads) were erased from the 30m DRA buffers to create an 'extracted forest roads' layer. FTEN roads were selected (BCGW_SOURCE = 'WHSE_FOREST_TENURE.FTEN_ROAD_SECTION_LINES_SVW') from the 'extracted forest roads' layer to create an 'extracted FTEN roads' layer. This layer was buffered by 30m. Non-DRA and non-FTEN roads were erased from the 30m FTEN buffers to	The BC CEF Integrated Roads dataset brings together roads from multiple sources. The multiple sources contain representations of some of same roads but do not have identical geometries. BC CEF processes the roads to remove as many duplicate representations as possible. PSF further applies this 30m buffering extraction process to further reduce duplicates. This 30m buffer approach is "heavy-handed" and produces a roads dataset with minimal duplication but does also remove some valid connecting road segments (particularly

Impact Category	Indicator	Units	Definition	Data Source	Dataset(s)	Processing	Notes
						create an 'extracted other forest roads' layer. The DRA roads, extracted FTEN roads, and extracted other forest roads layers were merged to produce a single road layer. The road data were overlaid (identity process) with watersheds. Road length was summarized by watershed and divided by watershed area to calculate road density per watershed (km/km^2).	where two different types of road sources intersect). The resulting road layer is appropriate for density calculations at the watershed scale but does not represent a connected road network.
Fish Passage/ **Habitat Connectivity**	Stream Crossing Density	# crossings/km of salmon accessible stream	The total number of stream crossings per km of the total length of modeled salmon habitat in a watershed.	BC Ministry of Environment and Climate Change Strategy	BC MOE Fish Habitat Model	Fish habitat arc and stream crossing points classified as 15% or less gradient were overlaid with the watersheds layer. Inferred and observed fish habitat was merged into a single 'fish habitat' group. A total number of fish habitat crossings per total length of fish habitat was calculated for each watershed.	Note, the fish habitat and stream crossings data are based on modeled data. For more information on the accessible stream length input data, contact Craig Mount, BC Ministry of Environment and Climate Change Strategy.
Water Quantity	Water Licenses	# of permitted water licenses	The total number of water licences permitted for water	DataBC	BC Points of Diversion (POD) with Water License	POD features were clipped using watersheds. Only current water licenses were used. Clipped point data were overlaid with watershed using the 'identity' process. The total number of POD	

Impact Category	Indicator	Units	Definition	Data Source	Dataset(s)	Processing	Notes
			withdrawal for domestic, industrial, agricultural, power, and storage uses from points of diversion within a watershed.		Information	locations was summarized by watershed. Licenses were also classified into classes: power, domestic, agriculture, industrial, or storage using the PURPOSE attribute.	
Water Quality	Waste Water Discharges	# of permitted waste water discharges	The number of permitted waste water management discharge sites within a watershed.	BC Ministry of Environment and Climate Change Strategy	Waste Water Discharge and Permits database	Active effluent waste water discharge locations, converted to spatial point features, were overlaid with the watersheds layer. The total number of discharge locations was summarized by watershed.	Type of discharge and amount are not currently tracked or incorporated in the analysis.

Table A. 19. Spatial Data Processing for Habitat Pressure Indicators applied in the Columbia Region.

Impact Category	Indicator	Units	Definition	Data Source	Dataset(s)	Processing	Notes
Human Development Footprint	Total Land Cover Alteration	% watershed area	The percentage of the total watershed area that has been altered by human activity.	BC Cumulative Effects Framework DataBC	Human Disturbance with Base Thematic Mapping Integrated Roads Historical Fire Perimeters Current Fire Perimeters Harvested Areas of BC (Consolidated Cutblocks)	Disturbance polygons were extracted from BC CEF's Human Disturbance with Base Thematic Mapping dataset for: mountain pine beetle, railway and airports, recreation, transmission lines, major rights of ways, mining, oil & gas infrastructure, seismic infrastructure, agriculture and urban areas Harvested area polygons were extracted from DataBC's Harvested Areas (Consolidated Cutblocks) dataset. Areas where logging had occurred greater than 60 years ago were not considered. The linear road features from the road development indicator (sourced from BC CEF's Integrated Roads dataset) were buffered by their corresponding road width, calculated as (number of lanes) × (8 m for freeways/highways or 5 m for everything else). Where the number of lanes attribute was not known (i.e. forest roads), the road was assumed to be 1 lane. Burned area polygons were selected from the Current and Historical Fire Perimeters datasets (fires in the last 20 years were selected).	The land cover alteration layer is used as an input to the riparian disturbance, impervious surfaces, and ECA indicators.

Impact Category	Indicator	Units	Definition	Data Source	Dataset(s)	Processing	Notes
						All disturbance polygons were combined and planarized; where different disturbances type polygons overlapped, the following priority order was used to determine the disturbance category of the overlapping area (highest priority first): road, mining, rail, oil & gas infrastructure, power, right of way, urban, recreation, oil and gas geophysical, forestry, fire, agriculture. The land cover alteration layer was overlaid with the watersheds. Total altered land area for any watershed is a sum of all land cover polygons in that watershed.	
	Mining Development	# of mines	The number of active and past-producing coal, mineral, or aggregate (gravel) mine sites within a watershed.	BC Ministry of Energy, Mines, and Petroleum Resources DataBC	Aggregate Inventory MINFILE Placer tenures	Past producing and producing mineral and coal mines were extracted from MINFILE and combined with aggregate mines. Placer mine tenure polygons were converted to point features (centre point) with one point per unique placer mine. These mine locations were then overlaid with the watersheds layer and the total number of mines were calculated for each watershed.	Aggregate mining data is outdated (2004) and may not represent the best available data.
	Impervious Surfaces	% watershed area	The percentage of the total watershed area that is represented by hard,	See Total Land Cover Alteration indicator for data sources	Urban, road, rail, and agriculture polygons	Urban, road, rail, and agriculture polygons were combined (union process) and overlaid with the watersheds layer. An impervious surfaces coefficient (ISC) attribute was added to each polygon, representing the proportional area of that land cover that can be	

Impact Category	Indicator	Units	Definition	Data Source	Dataset(s)	Processing	Notes
			impervious surfaces (e.g. paved).			considered impervious. ISC values were calculated using the average ISC for land cover categories as defined by Prisloe et al. 2003, for medium population density areas (>= 500 but < 1800 people/square mile). The following ISC values were applied to each area of each polygon: urban (0.19878), agriculture (0.0719), roads (1.0), rail (1.0). All ISC adjusted polygon areas were then summed to give the total impervious surface area for each watershed.	
	Linear Development	km/km^2	The density of linear developments within a watershed	BC Cumulative Effects Framework Geogratis	Integrated Roads CanVec	Roads, pipelines (not present on Haida Gwaii), power lines, trails, and railway lines were combined into one linear feature layer, which was overlaid with the watersheds layer. The sum of the line length was calculated for each watershed. This length was then divided by the total watershed area to give a linear feature density for each watershed.	See the road development indicator for notes that apply here also. Power line, trail, and railway data from the CanVec dataset is outdated (1998) and may not represent the best available data.

Impact Category	Indicator	Units	Definition	Data Source	Dataset(s)	Processing	Notes
Hydrologic Processes	Forest Disturbance	% of watershed	The percentage of total watershed area that has been disturbed by logging and burning in the last 60 years.	DataBC	Harvested Areas of BC (Consolidated Cutblocks) Current Fire Perimeters Historical Fire Perimeters	Forestry polygons were filtered to harvest within the last 60 years. Fire polygons were filtered to fires within the last 20 years. Harvested and burned area polygons were overlaid with the watersheds layer to calculate total forested area per watershed.	
	Equivalent Clearcut Area (ECA)	% of watershed	The percentage of total watershed area that is considered comparable to a clearcut forest.	DataBC See Total Land Cover Alteration indicator for additional data sources	Vegetation Resources Inventory (VRI)	Disturbance polygons were selected from the total land cover alteration dataset and categorized as recoverable (harvested areas, burned areas, and areas impacted by mountain pine beetle and non-recoverable (railway and airports, transmission lines, major rights of ways, mining, oil & gas infrastructure, seismic infrastructure, agriculture and urban areas). A "non-recoverable" layer was created by first merging and dissolving all non-recoverable disturbance types. Harvested and burned area polygons were dissolved based on projected stand height and then merged with the non-recoverable layer. Lastly, harvested area and burned area polygons without stand height but with a date of	BC Cumulative Effects Framework (BC CEF) ECA method includes an additional step to approximate stand height where not available in VRI before defaulting to this time since disturbance surrogate ECA estimate. This data was not available to us at the time of our assessments but our upcoming work to

Impact Category	Indicator	Units	Definition	Data Source	Dataset(s)	Processing	Notes
					Disturbance polygons	disturbance were dissolved based on time since disturbance (years) and merged with the non-recoverable and recoverable polygons with stand height. This combined ECA layer was overlaid with the FWA assessment watersheds. The growth recovery of each polygon was calculated based on stand height using the coastal recovery curve or using a time since disturbance surrogate method where stand height information was not readily available. The growth recovery of each recoverable polygon with stand height information was calculated using the following equation: ECA = A*C(1-R/100) where A is the original polygon area, C is the proportion of the opening covered by functional regeneration (determined from Table A2.1, MOF 2001), and R is the recovery factor (for coastal forests from Hudson, R., and G. Horel. 2007 and from Winkler, R., and S. Boon. 2015 for interior forests). For non-recoverable polygons, there is no functional regeneration or recovery factor, so for these polygons C will be equal to 1 and R will be equal to 0. Where stand height is not available (e.g. for harvested areas sourced from Gowgaia Institute) a	revise our habitat indicator methods will aim to source ECA directly from BC CEF or to update our methods to fill stand height data gaps where possible.

Impact Category	Indicator	Units	Definition	Data Source	Dataset(s)	Processing	Notes
						time since disturbance surrogate was used to estimate ECA: 1-10 yrs = 100% ECA, 11-20 = 75%, 21-40 = 25% and 40-50 yrs = 5%, >50 years = 0%. The ECA layer was overlaid with the watersheds. ECA was summed for each FWA watershed then divided by the total watershed area to give an ECA percentage for each watershed.	
Vegetation Quality	Riparian Disturbance	% watershed area	The percentage of the riparian area that has been altered by human activity (forest disturbance, urban land use, agricultural/ rural land use, mining development, and other development).	DataBC	Freshwater Atlas: Stream network, lakes, wetlands. Total Land Cover Alteration restricted to the riparian zone (30m buffer around all water bodies).	A layer representing the riparian zone (30m buffer around streams and water bodies) was created for each Region. Stream features were buffered by 30m (including only ditch and canal features that intersected the streams). An overlay (identity process) was performed using the buffered stream features and watershed layer. The resulting layer was dissolved by watershed ID. Lake and wetland features were merged into one layer and buffered by 30m (isolated lakes and wetlands away from the stream network were not included). Buffer features resulting from islands or donuts in the water bodies were removed.	This indicator is derived from the total land cover alteration indicator, see total land cover alteration for processing details.

Impact Category	Indicator	Units	Definition	Data Source	Dataset(s)	Processing	Notes
						Prior to buffering lakes and wetlands, all features in those layers coincident with stream arcs FTRCD WA24111170 (isolated water bodies) were selected and extracted. These extracted isolated water bodies were overlaid with the stream network, and features intersecting the streams were selected and added to the water body layer for buffering in case a water body was incorrectly tagged as 'isolated' in the dataset. An overlay (identity process) was performed using the buffered water body features and the watershed layer. The resulting layer was dissolved by watershed ID. River features were buffered by 30m. Buffer features around islands or donuts were also removed. An overlay (identity process) was performed using the buffered river features and the watershed layer. The resulting layer was dissolved by watershed ID. The buffer layers for streams, water bodies, and rivers were merged into one layer and dissolved by watershed ID. The resulting layer was overlaid (identity process)	

Impact Category	Indicator	Units	Definition	Data Source	Dataset(s)	Processing	Notes
						with the total land cover alteration layer. Riparian disturbance was summarized by area (in hectares) and percentage of total riparian area per watershed.	
	Insect and Disease Defoliation	% watershed area	The percentage of pine forests that have been killed by insects or disease.	DataBC	Vegetation Resources Inventory (VRI)	VRI was overlaid (identity process) with the watersheds layer. VRI polygons for dead and live stand volumes were summarized by watershed, using the maximum value in the 3 dead/live volume utility levels for each stand. Percentage of the forest stand killed was calculated as: (sum of dead stand volume)/(sum of dead stand volume + sum of live stand volume)	Conversion of live standing volume to dead volume in the VRI follows predictions made using the provincial MPB model and the 2010 aerial overview surveys.
Surface Erosion	Road Development	km/km^2	The average density of all roads within a watershed	BC Cumulative Effects Framework	Integrated Roads	Roads were clipped to the region boundary. DRA roads were selected (BCGW_SOURCE = 'WHSE_BASEMAPPING.TRANSPORT_LINE') and buffered by 30m. Non-DRA roads (forest roads) were erased from the 30m DRA buffers to create an 'extracted forest roads' layer. FTEN roads were selected (BCGW_SOURCE = 'WHSE_FOREST_TENURE.FTEN_ROAD_SECTION_LINES_SVW') from the 'extracted forest roads' layer to create an 'extracted FTEN roads' layer. This layer was buffered by 30m. Non-DRA and non-FTEN	The BC CEF Integrated Roads dataset brings together roads from multiple sources. The multiple sources contain representations of some of same roads but do not have identical geometries. BC CEF processes the roads to remove

Impact Category	Indicator	Units	Definition	Data Source	Dataset(s)	Processing	Notes
						roads were erased from the 30m FTEN buffers to create an 'extracted other forest roads' layer. The DRA roads, extracted FTEN roads, and extracted other forest roads layers were merged to produce a single road layer. The road data were overlaid (identity process) with watersheds. Road length was summarized by watershed and divided by watershed area to calculate road density per watershed (km/km^2).	as many duplicate representations as possible. PSF further applies this 30m buffering extraction process to further reduce duplicates. This 30m buffer approach is "heavy-handed" and produces a roads dataset with minimal duplication but does also remove some valid connecting road segments (particularly where two different types of road sources intersect). The resulting road layer is appropriate for density calculations at the watershed scale but does not represent a connected road network.

Impact Category	Indicator	Units	Definition	Data Source	Dataset(s)	Processing	Notes
Fish Passage/ Habitat Connectivity	Stream Crossing Density	# crossings/km of salmon accessible stream	The total number of stream crossings per km of the total length of modeled salmon habitat in a watershed.	BC Ministry of Environment and Climate Change Strategy	BC MOE Fish Habitat Model	Fish habitat arc and stream crossing points classified as 15% or less gradient were overlaid with the watersheds layer. Inferred and observed fish habitat was merged into a single 'fish habitat' group. A total number of fish habitat crossings per total length of fish habitat was calculated for each watershed.	Note, the fish habitat and stream crossings data are based on modeled data. For more information on the accessible stream length input data, contact Craig Mount, BC Ministry of Environment and Climate Change Strategy.
Water Quantity	Water Licenses	# of permitted water licenses	The total number of water licences permitted for water withdrawal for domestic, industrial, agricultural, power, and storage uses from points of diversion within a watershed.	DataBC	BC Points of Diversion (POD) with Water License Information	POD features were clipped using watersheds. Only current water licenses were used. Clipped point data were overlaid with watershed using the 'identity' process. The total number of POD locations was summarized by watershed. Licenses were also classified into classes: power, domestic, agriculture, industrial, or storage using the PURPOSE attribute.	

Impact Category	Indicator	Units	Definition	Data Source	Dataset(s)	Processing	Notes
Water Quality	Waste Water Discharges	# of permitted waste water discharges	The number of permitted waste water management discharge sites within a watershed.	BC Ministry of Environment and Climate Change Strategy	Waste Water Discharge and Permits database	Active effluent waste water discharge locations, converted to spatial point features, were overlaid with the watersheds layer. The total number of discharge locations was summarized by watershed.	Type of discharge and amount are not currently tracked or incorporated in the analysis.

Appendix 9: Spatial Data Processing for Future Pressures

Table A. 20. Spatial Data Processing for Future Pressures.

Future Pressure Dataset	Data Source	Processing Steps	Limitations
Existing Oil and Gas Pipelines	Eclipse GIS (Johanna Pfalz) DataBC	Routes were updated in 2016 based on project descriptions and maps from the BC Environmental Assessment Office (BC EAO). Pipelines from the Oil and Gas Commission Pipeline Segment Permits dataset with an 'Active' status were selected. These were cross-referenced and modified as needed based on maps from proponent websites (e.g. TransMountain, Enbridge, FortisBC).	Digitized data can be inaccurate and locations of digitized features should be viewed as illustrative rather than definitive.
Proposed Oil and Gas Pipelines	Eclipse GIS (Johanna Pfalz)	Routes were updated in 2016 based on project descriptions and maps from the BC Environmental Assessment Office (BC EAO). Pipelines from the Oil and Gas Commission Pipeline Segment Permits dataset with a 'New' status were	Digitized data can be inaccurate and locations of digitized features should be viewed as illustrative rather than definitive.

Future Pressure Dataset	Data Source	Processing Steps	Limitations
	DataBC	selected. These were cross-referenced and modified as needed based on maps from proponent websites (e.g. TransMountain, Enbridge, FortisBC).	
Existing Mining Development	Coal and mineral mine locations: BC Ministry of Energy and Mines MINFILE shapefile. Aggregate mines: BC Ministry of Energy, Mines and Petroleum Resources aggregate file. Placer mines: BC Ministry of Forests, Lands, Natural Resource Operations and Rural Development via DataBC	MINFILE: All 'producer' and 'past producer' mines were selected. Coordinates in the aggregate file were used to generate spatial point data. Polygons were converted to point features with one point per unique placer tenure.	NA
Proposed Mining Development	Coal and mineral mine locations: BC Ministry of Energy and Mines MINFILE shapefile.	Only mineral occurrences shown as 'developed prospect' are shown.	NA
Existing Water Licenses	BC Ministry of Forests, Lands, Natural Resource Operations and Rural Development via DataBC.	All 'current' water licenses were selected and categorized into the following class types: power, agriculture,	NA

Future Pressure Dataset	Data Source	Processing Steps	Limitations
		industrial, storage, or residential. Residential licences were removed from the dataset.	
Proposed Water Licenses	BC Ministry of Forests, Lands, Natural Resource Operations and Rural Development via DataBC.	All 'current' water licenses were selected and categorized into the following class types: power, agriculture, industrial, storage, or residential. Residential licences were removed from the dataset.	NA
Existing Hydroelectric Power Lines	Natural Resources Canada DataBC	For the Skeena, Nass and Central Coast Regions, existing power lines were sourced from the Natural Resources Canada's CanVec 1:250,000 transmission line dataset. For the Fraser, VIMI, Haida Gwaii, and Columbia regions, power lines were sourced from the DataBC BC Transmission Lines dataset.	The resolution of the CanVec data does not show all power lines.
Proposed Hydroelectric Power Lines	BC Hydro	Proposed transmission lines were digitized by PSF from a 2019/2020 Transmission System map available from BC Hydro's website.	Digitized data can be inaccurate and locations of digitized features should be viewed as illustrative rather than definitive.

Future Pressure Dataset	Data Source	Processing Steps	Limitations
Existing Hydroelectric Power Tenures	BC Ministry of Forests, Lands, Natural Resource Operations and Rural Development via DataBC.	Source dataset was filtered to include only 'water power' projects in the 'tenure' stage.	NA
Proposed Hydroelectric Power Tenures	BC Ministry of Forests, Lands, Natural Resource Operations and Rural Development via DataBC.	Source dataset was filtered to include only 'wind power' projects in the 'application' stage.	NA
Existing Wind Power Tenures	BC Ministry of Forests, Lands, Natural Resource Operations and Rural Development via DataBC.	Source dataset was filtered to include only 'wind power' projects in the 'tenure' stage.	NA
Proposed Wind Power Tenures	BC Ministry of Forests, Lands, Natural Resource Operations and Rural Development via DataBC.	Source dataset was filtered to include only 'wind power' projects in the 'application' stage.	NA
Timber Harvesting Landbase	BC Ministry of Forests, Lands, Natural Resource Operations and Rural Development.	No additional processing.	The Timber Harvesting Landbase (THLB) dataset includes only timber supply area (TSA) lands. Some Tree Farm License (TFL) THLB data may exist but is not considered current. The most up to date data for TFLs can only be obtained with the permission of the licensee.

Appendix 10: Identifying Outliers for Habitat Assessment Indicator Values

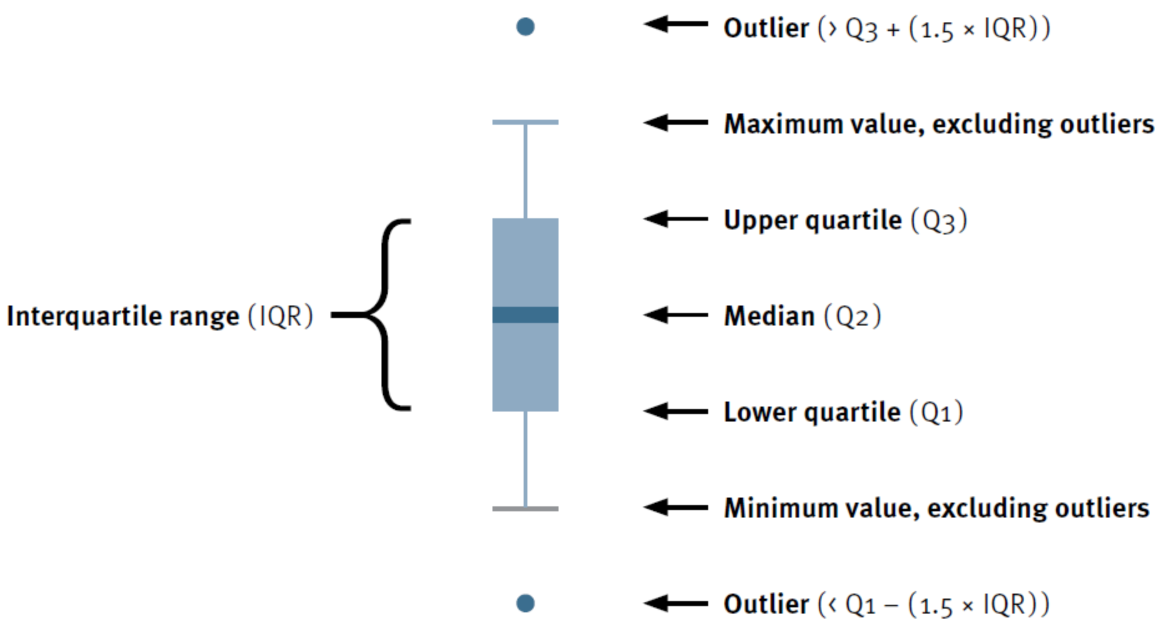

Figure A.45. Illustration depicting the key values in a "box plot." We use box plots to show the distribution of data and assign a relative risk score to a habitat pressure indicator value.

The plot includes a box indicating the inner 50th percentile of the data, whiskers showing the robust data range, outliers, and median. The top and bottom of the box are the 25th (Q1) and 75th (Q3) percentiles. The size of the box is called the interquartile range (IQR) and is defined as IQR = Q3 − Q1. The whiskers extend to the most extreme data points, which are not considered outliers. The horizontal line inside the box represents the median (50th percentile, Q2). Data that fall outside the IQR box by a specific amount are considered "outliers." Outliers are values greater than 1.5 × IQR outside of the IQR. (Modified from Porter et al. 2016).

Appendix 11: Roll-up Rules for Salmon Habitat Assessments

Table A. 21. 1st level roll-up rule set (within impact categories) and 2nd level roll-up rule set (across impact categories) for developing cumulative habitat risk ratings for watersheds within salmon Conservation Unit zones of influence (ZOIs).

Impact Category	Indicator	1st level Roll-Up Rule	2nd Level Roll-Up Rule
Hydrologic processes	Equivalent Clearcut Area Forest disturbance	If ≥ 1 indicator is rated red, then impact category is red; if 2 indicators are rated green then the impact category is green; otherwise the impact category is amber.	If ≥ 3 impact categories are rated red, then the cumulative risk rating is **red (high risk)**. If ≥ 5 impact categories are rated green, then the cumulative risk rating is **green (low risk)**. For all other cases (< 5 impact categories are green, or <3 impact categories are red), the cumulative risk rating is **amber (moderate risk)**.
Surface erosion	Road density	If the indicator rated green, then the impact category rated green; if the indicator rated amber then the impact category is rated amber; if the indicator rated red, then impact category rated red.	
Fish passage and habitat connectivity	Stream crossing density	If the indicator rated green, then impact category rated green; if the indicator rated amber then impact category rated amber; if the indicator rated red, then impact category rated red.	
Vegetation quality	Riparian disturbance Insect & disease defoliation	If ≥ 1 indicator is rated red, then impact category is red; if 2 indicators are rated green then the impact category is green, otherwise the impact category is amber.	
Water quantity	Water licenses	If the indicator rated green, then impact category rated green; if the indicator rated amber then impact category rated amber; if the indicator rated red, then impact category rated red.	
Water quality	Waste water discharge	If the indicator rated green, then impact category rated green; if the indicator rated amber then impact category rated amber; if	

		the indicator rated red, then impact category rated red.	
Human development footprint	Total land cover alteration	If ≥ 2 indicators are rated red, then impact category is red; if ≥ 3 indicators are rated green then the impact category is green, otherwise the impact category is amber.	
	Impervious surfaces		
	Linear development		
	Mining development		

Appendix 12: Habitat Pressure Benchmark Values by Region

Skeena Region

Table A. 22. The specific units, benchmark assessment type, associated values, and references used to assign risk ratings to each individual indicator. Given the availability of data the benchmark type and associated values are specific to the Skeena Region.

Impact Category	Indicator	Units	Benchmark Type	Benchmarks			Benchmark Reference
				Low Risk (green)	Medium Risk (amber)	High Risk (red)	
Hydrologic Processes	Forest disturbance	% of watershed	Relative ranking	< 4.8	≥ 4.8 to < 19.0	≥ 19.0	n/a
	Equivalent Clearcut Area (ECA)	% of watershed	green/amber - science- & expert-based; amber/red - science-based	< 15	≥ 15 to < 20	≥ 20	green/amber - NOAA 1996, MOF 2001; amber/red - Summit/MOE
Surface Erosion	Road development	km/km2	green/amber - science- & expert-based; amber/red - science-based	< 0.4	≥ 0.4 to < 1.2	≥ 1.2	green/amber - Stalberg et al. 2009; amber/red – MOF 1995a,b & Porter et al. 2012
Fish Passage/ Habitat Connectivity	Stream crossing density	# crossings/km of salmon accessible stream	Relative ranking	< 0.2	≥ 0.2 to < 0.58	≥ 0.58	n/a
Vegetation Quality	Insect and disease defoliation	% forest stands killed	Relative ranking	< 3.3	≥ 3.3 to < 15	≥ 15	n/a
	Riparian disturbance	% of riparian zone	green/amber - science- & expert-based; amber/red - science-based	< 5	≥ 5 to < 15	≥ 15	green/amber - Stalberg et al. 2009; amber/red - Tripp and Bird 2004

Impact Category	Indicator	Units	Benchmark Type	Benchmarks			Benchmark Reference
				Low Risk (green)	Medium Risk (amber)	High Risk (red)	
Water Quantity	Licensed water use permits	# of water licenses	Binary ranking	0	n/a	> 0	n/a
Water Quality	Waste water discharges	# of discharges	Binary ranking	0	n/a	> 0	n/a
Human Development Footprint	Total land cover alteration	% of watershed	Relative ranking	< 6.4	≥ 6.4 to < 22.0	≥ 22.0	n/a
	Linear development	km/km2	Relative ranking	<0.59	≥ 5.9 to < 1.3	≥ 1.3	n/a
	Mining development	# of mines	Binary ranking	0	n/a	> 0	n/a
	Impervious surface (urban & agricultural/rural development)	% of watershed	green/amber - science- & expert-based; amber/red - science-based	< 3	≥ 3 to < 10	≥ 10	Paul and Meyer 2001, Smith 2005

Nass Region

Table A. 23. The specific units, benchmark assessment type, associated values, and references used to assign risk ratings to each individual indicator. Given the availability of data the benchmark type and associated values are specific to the Nass Region.

Impact Category	Indicator	Units	Benchmark Type	Benchmarks			Benchmark Reference
				Low Risk (green)	Medium Risk (amber)	High Risk (red)	
Hydrologic Processes	Forest disturbance	% of watershed	Relative ranking	0	> 0 to < 10.0	≥ 10.0	n/a
	Equivalent Clearcut Area (ECA)	% of watershed	green/amber - science- & expert-based; amber/red - science-based	< 15	≥ 15 to < 20	≥ 20	green/amber - NOAA 1996, MOF 2001; amber/red - Summit/MOE
Surface Erosion	Road development	km/km2	green/amber - science- & expert-based; amber/red - science-based	< 0.4	≥ 0.4 to < 1.2	≥ 1.2	green/amber - Stalberg et al. 2009; amber/red – MOF 1995a,b & Porter et al. 2012
Fish Passage/ Habitat Connectivity	Stream crossing density	# crossings/km of salmon accessible stream	Relative ranking	0	> 0 to < 0.25	≥ 0.25	n/a
Vegetation Quality	Insect and disease defoliation	% forest stands killed	Binary ranking	0	n/a	> 0	n/a
	Riparian disturbance	% of riparian zone	green/amber - science- & expert-based; amber/red - science-based	< 5	≥ 5 to < 15	≥ 15	green/amber - Stalberg et al. 2009; amber/red - Tripp and Bird 2004

Impact Category	Indicator	Units	Benchmark Type	Benchmarks			Benchmark Reference
				Low Risk (green)	Medium Risk (amber)	High Risk (red)	
Water Quantity	Licensed water use permits	# of water licenses	Binary ranking	0	n/a	> 0	n/a
Water Quality	Waste water discharges	# of discharges	Binary ranking	0	n/a	> 0	n/a
Human Development Footprint	Total land cover alteration	% of watershed	Relative ranking	0	> 0 to < 12.0	≥ 12.0	n/a
	Linear development	km/km2	Relative ranking	0	> 0 to < 0.59	≥ 0.59	n/a
	Mining development	# of mines	Binary ranking	0	n/a	> 0	n/a
	Impervious surface (urban & agricultural/rural development)	% of watershed	green/amber - science- & expert-based; amber/red - science-based	< 3	≥3 to < 10	≥ 10	Paul and Meyer 2001, Smith 2005

Central Coast Region

Table A. 24. The specific units, benchmark assessment type, associated values, and references used to assign risk ratings to each individual indicator. Given data availability, the benchmark type and associated values are specific to the Central Coast Region.

Impact Category	Indicator	Units	Benchmark Type	Benchmarks			Benchmark Reference
				Low Risk (green)	Medium Risk (amber)	High Risk (red)	
Hydrologic Processes	Forest disturbance	% of watershed	relative ranking	0	> 0	≥ 9	n/a
	Equivalent Clearcut Area (ECA)	% of watershed	green/amber - science- & expert-based; amber/red - science-based	< 15	≥ 15 to < 20	≥ 20	green/amber - NOAA 1996, MOF 2001; amber/red - Summit/MOE
Surface Erosion	Road development	km/km2	green/amber - science- & expert-based; amber/red - science-based	< 0.4	≥ 0.4 to < 1.2	≥ 1.2	green/amber - Stalberg et al. 2009; amber/red – MOF 1995a,b & Porter et al. 2012
Fish Passage/ Habitat Connectivity	Stream crossing density	# crossings/km of salmon accessible stream	relative ranking	0	> 0	≥ 0.15	n/a
Vegetation Quality	Insect and disease defoliation	% forest stands killed	binary ranking	0	n/a	> 0	n/a
	Riparian disturbance	% of riparian zone	green/amber - science- & expert-based; amber/red - science-based	< 5	≥ 5 to < 15	≥ 15	green/amber - Stalberg et al. 2009; amber/red - Tripp and Bird 2004
Water Quantity	Licensed water use permits	# of water licenses	binary ranking	0	n/a	> 0	n/a

Impact Category	Indicator	Units	Benchmark Type	Benchmarks			Benchmark Reference
				Low Risk (green)	Medium Risk (amber)	High Risk (red)	
Water Quality	Waste water discharges	# of discharges	binary ranking	0	n/a	> 0	n/a
Human Development Footprint	Total land cover alteration	% of watershed	relative ranking	0	> 0	≥ 15	n/a
	Linear development	km/km2	relative ranking	0	> 0	≥ 0.84	n/a
	Mining development	# of mines	binary ranking	0	n/a	> 0	n/a
	Impervious surface (urban & agricultural/rural	% of watershed	science- & expert-based	< 3	≥3 to < 10	≥ 10	Paul and Meyer 2001, Smith 2005

Fraser Region

Table A. 25. The specific units, benchmark assessment type, associated values, and references used to assign risk ratings to each individual indicator. Given data availability, the benchmark type and associated values are specific to the Fraser Region.

Impact Category	Indicator	Units	Benchmark Type	Benchmarks: Low Risk (green)	Benchmarks: Medium Risk (amber)	Benchmarks: High Risk (red)	Benchmark Reference
Hydrologic Processes	Forest disturbance	% of watershed	relative ranking (50^{th}, 75^{th})	< 12.7	≥ 12.7 to < 27.3	≥ 27.3	n/a
	Equivalent Clearcut Area (ECA)	% of watershed	green/amber - science- & expert-based; amber/red - science-based	< 15	≥ 15 to < 20	≥ 20	green/amber - NOAA 1996, MOF 2001; amber/red -
Surface Erosion	Road development	km/km2	green/amber - science- & expert-based; amber/red - science-based	< 0.4	≥ 0.4 to < 1.2	≥ 1.2	green/amber - Stalberg et al. 2009; amber/red – MOF 1995a,b & Porter et al. 2012
Fish Passage/ Habitat Connectivity	Stream crossing density	# crossings/km of salmon accessible stream	relative ranking (outliers)	0	> 0	≥ 1.5	n/a
Vegetation Quality	Insect and disease defoliation	% forest stands killed	relative ranking (50^{th}, 75^{th})	< 5.6	≥ 5.6 to < 19.9	≥ 19.9	n/a
	Riparian disturbance	% of riparian zone	green/amber - science- & expert-based; amber/red - science-based	< 5	≥ 5 to < 15	≥ 15	green/amber - Stalberg et al. 2009; amber/red - Tripp and Bird 2004

Impact Category	Indicator	Units	Benchmark Type	Benchmarks			Benchmark Reference
				Low Risk (green)	Medium Risk (amber)	High Risk (red)	
Water Quantity	Licensed water use permits	# of water licenses	binary ranking	0	n/a	> 0	n/a
Water Quality	Waste water discharges	# of discharges	binary ranking	0	n/a	> 0	n/a
Human Development Footprint	Total land cover alteration	% of watershed	relative ranking (50^{th}, 75^{th})	< 21.4	$\geq$ 21.4 to < 40.8	$\geq$ 40.8	n/a
	Linear development	km/km2	relative ranking (50^{th}, 75^{th})	< 1.5	$\geq$ 1.5 to < 2.3	$\geq$ 2.3	n/a
	Mining development	# of mines	binary ranking	0	n/a	> 0	n/a
	Impervious surface (urban & agricultural/rural	% of watershed	science- & expert-based	< 3	$\geq$ 3 to < 10	$\geq$ 10	Paul and Meyer 2001, Smith 2005

Vancouver Island & Mainland Inlets Region

Table A. 26. The specific units, benchmark assessment type, associated values, and references used to assign risk ratings to each individual indicator. Given data availability, the benchmark type and associated values are specific to the VIMI Region.

Impact Category	Indicator	Units	Benchmark Type	Benchmarks			Benchmark Reference
				Low Risk (green)	Medium Risk (amber)	High Risk (red)	
Hydrologic Processes	Forest disturbance	% of watershed	relative ranking (50th, 75th)	< 6.1	≥ 6.1 to < 14.9	≥ 14.9	n/a
	Equivalent Clearcut Area (ECA)	% of watershed	green/amber - science- & expert-based; amber/red - science-based	< 15	≥ 15 to < 20	≥ 20	green/amber - NOAA 1996, MOF 2001; amber/red -
Surface Erosion	Road development	km/km2	green/amber - science- & expert-based; amber/red - science-based	< 0.4	≥ 0.4 to < 1.2	≥ 1.2	green/amber - Stalberg et al. 2009; amber/red – MOF 1995a,b & Porter et al. 2012
Fish Passage/ Habitat Connectivity	Stream crossing density	# crossings/km of salmon accessible stream	relative ranking (outliers)	0	> 0	≥ 1.7	n/a
Vegetation Quality	Insect and disease defoliation	% forest stands killed	binary ranking	0	n/a	> 0	n/a
	Riparian disturbance	% of riparian zone	green/amber - science- & expert-based; amber/red - science-based	< 5	≥ 5 to < 15	≥ 15	green/amber - Stalberg et al. 2009; amber/red - Tripp and Bird 2004

Impact Category	Indicator	Units	Benchmark Type	Benchmarks			Benchmark Reference
				Low Risk (green)	Medium Risk (amber)	High Risk (red)	
Water Quantity	Water licenses	# of water licenses	binary ranking	0	n/a	> 0	n/a
Water Quality	Waste water discharges	# of discharges	binary ranking	0	n/a	> 0	n/a
Human Development Footprint	Total land cover alteration	% of watershed	relative ranking (50^{th}, 75^{th})	< 8.6	$\geq$ 8.6 to < 18.3	$\geq$ 18.3	n/a
	Linear development	km/km2	relative ranking (50^{th}, 75^{th})	< 1	$\geq$ 1 to < 2.5	$\geq$ 2.5	n/a
	Mining development	# of mines	binary ranking	0	n/a	> 0	n/a
	Impervious surface (urban & agricultural/rural	% of watershed	science- & expert-based	< 3	$\geq$3 to < 10	$\geq$ 10	Paul and Meyer 2001, Smith 2005

Haida Gwaii Region

Table A. 27. The specific units, benchmark assessment type, associated values, and references used to assign risk ratings to each individual indicator. Given data availability, the benchmark type and associated values are specific to the Haida Gwaii Region.

Impact Category	Indicator	Units	Benchmark Type	Benchmarks: Low Risk (green)	Benchmarks: Medium Risk (amber)	Benchmarks: High Risk (red)	Benchmark Reference
Hydrologic Processes	Forest disturbance	% of watershed	Relative ranking	< 4.6	> 4.6 to < 24.7	≥ 24.7	n/a
	Equivalent Clearcut Area (ECA)	% of watershed	green/amber - science- & expert-based; amber/red - science-based	< 15	≥ 15 to < 20	≥ 20	green/amber - NOAA 1996, MOF 2001; amber/red - Summit/MOE
Surface Erosion	Road development	km/km2	green/amber - science- & expert-based; amber/red - science-based	< 0.4	≥ 0.4 to < 1.2	≥ 1.2	green/amber - Stalberg et al. 2009; amber/red – MOF 1995a,b & Porter et
Fish Passage/ Habitat Connectivity	Stream crossing density	# crossings/km of salmon accessible stream	Relative ranking	0	> 0 to < 0.85	≥ 0.85	n/a
Vegetation Quality	Insect and disease defoliation	% forest stands killed	Binary ranking	0	n/a	> 0	n/a
	Riparian disturbance	% of riparian zone	green/amber - science- & expert-based; amber/red - science-based	< 5	≥ 5 to < 15	≥ 15	green/amber - Stalberg et al. 2009; amber/red - Tripp and Bird 2004
Water Quantity	Water licenses	# of water licenses	Binary ranking	0	n/a	> 0	n/a

Impact Category	Indicator	Units	Benchmark Type	Benchmarks			Benchmark Reference
				Low Risk (green)	Medium Risk (amber)	High Risk (red)	
Water Quality	Waste water discharges	# of discharges	Binary ranking	0	n/a	> 0	n/a
Human Development Footprint	Total land cover alteration	% of watershed	Relative ranking	< 5.4	> 5.4 to < 25.8	≥ 25.8	n/a
	Linear development	km/km2	Relative ranking	0	> 0 to < 0.38	≥ 0.38	n/a
	Mining development	# of mines	Binary ranking	0	n/a	> 0	n/a
	Impervious surface (urban & agricultural/rural	% of watershed	green/amber - science- & expert-based; amber/red - science-based	< 3	≥ 3 to < 10	≥ 10	Paul and Meyer 2001, Smith 2005

Columbia Region

Table A. 28. The specific units, benchmark assessment type, associated values, and references used to assign risk ratings to each individual indicator. Given data availability, the benchmark type and associated values are specific to the Columbia Region.

Impact Category	Indicator	Units	Benchmark Type	Benchmarks			Benchmark Reference
				Low Risk (green)	Medium Risk (amber)	High Risk (red)	
Hydrologic Processes	Forest disturbance	% of watershed	Relative ranking, 50th and 75th percentile	< 14	> 14 to < 30	≥ 30	n/a
	Equivalent Clearcut Area (ECA)	% of watershed	green/amber - science- & expert-based; amber/red - science-based	< 15	≥ 15 to < 20	≥ 20	green/amber - NOAA 1996, MOF 2001; amber/red - Summit/MOE
Surface Erosion	Road development	km/km2	green/amber - science- & expert-based; amber/red - science-based	< 0.4	≥ 0.4 to < 1.2	≥ 1.2	green/amber - Stalberg et al. 2009; amber/red – MOF 1995a,b & Porter et
Fish Passage/ Habitat Connectivity	Stream crossing density	# crossings/km of salmon accessible stream	Relative ranking, outliers	0	> 0 to < 1.8	≥ 1.8	n/a
Vegetation Quality	Insect and disease defoliation	% forest stands killed	Relative, outliers	0	> 0 to < 7.8	≥ 7.8	n/a
	Riparian disturbance	% of riparian zone	green/amber - science- & expert-based; amber/red - science-based	< 5	≥ 5 to < 15	≥ 15	green/amber - Stalberg et al. 2009; amber/red - Tripp and Bird 2004
Water Quantity	Water licenses	# of water licenses	Binary ranking	0	n/a	> 0	n/a

Impact Category	Indicator	Units	Benchmark Type	Benchmarks			Benchmark Reference
				Low Risk (green)	Medium Risk (amber)	High Risk (red)	
Water Quality	Waste water discharges	# of discharges	Binary ranking	0	n/a	> 0	n/a
Human Development Footprint	Total land cover alteration	% of watershed	Relative ranking 50^{th} and 75^{th} percentile	< 19	> 19 to < 37	≥ 37	n/a
	Linear development	km/km2	Relative ranking, 50^{th} and 75^{th} percentile	< 1.4	≥ 1.4 to < 2.5	≥ 2.5	n/a
	Mining development	# of mines	Binary ranking	0	n/a	> 0	n/a
	Impervious surfaces	% of watershed	green/amber - science- & expert-based; amber/red - science-based	< 3	≥ 3 to < 10	≥ 10	Paul and Meyer 2001, Smith 2005

Appendix 13: Cumulative Spawning Pressure Results by Region and Conservation Unit

Skeena Region

Table A. 29. The percentage of watersheds within each CU's spawning zone of influence that are rated high, moderate, or low risk (i.e. red, amber, green) for cumulative habitat pressures.

Skeena Region				
Species	**Conservation Unit**	**High Risk**	**Moderate Risk**	**Low Risk**
Chinook	Ecstall	10%	10%	80%
	Kalum-Early	23%	48%	29%
	Kalum-Late	51%	44%	5%
	Lakelse	62%	38%	0%
	Lower Skeena	16%	29%	55%
	Middle Skeena-Large Lakes	40%	35%	25%
	Middle Skeena-Mainstem Tributaries	39%	33%	28%
	Sicintine	0%	19%	81%
	Skeena Estuary	0%	100%	0%
	Upper Bulkley River	74%	26%	0%
	Upper Skeena	5%	14%	81%
	Zymoetz	17%	49%	34%
Chum	Lower Skeena	21%	30%	48%
	Middle Skeena	56%	39%	5%
	Skeena Estuary	30%	49%	21%
	Upper Skeena	0%	100%	0%

Skeena Region				
Species	**Conservation Unit**	**High Risk**	**Moderate Risk**	**Low Risk**
Coho	Lower Skeena	22%	36%	41%
	Middle Skeena	46%	37%	17%
	Skeena Estuary	30%	60%	10%
	Upper Skeena	3%	12%	85%
Pink (even-year)	Middle-Upper Skeena	55%	40%	5%
	Nass-Skeena Estuary	19%	42%	39%
Pink (odd-year)	Lower Skeena River	23%	34%	43%
	Middle-Upper Skeena	55%	40%	5%
	Nass-Skeena Estuary	27%	47%	25%
Sockeye (lake-type)	Alastair	0%	0%	100%
	Asitika	0%	0%	100%
	Azuklotz	0%	0%	100%
	Babine (enhanced)	56%	36%	8%
	Babine/Onerka	56%	36%	8%
	Bear	0%	18%	82%
	Bulkley/Maxan	100%	0%	0%
	Damshilgwit	0%	0%	100%
	Ecstall/Lower	0%	0%	100%
	Footsore/Hodder	0%	0%	100%
	Gitanyow (Kitwanga/Kitwancool)	34%	66%	0%
	Johanson	0%	59%	41%

Skeena Region				
Species	**Conservation Unit**	**High Risk**	**Moderate Risk**	**Low Risk**
	Johnston	0%	0%	100%
	Kitsumkalum	18%	44%	38%
	Kluatantan	0%	0%	100%
	Kluayaz	0%	0%	100%
	Lakelse	64%	31%	5%
	Mcdonell/Dennis/Aldrich	41%	42%	16%
	Morice/Atna	13%	2%	85%
	Motase	0%	0%	100%
	Nilkitkwa	40%	49%	11%
	Sicintine	0%	0%	100%
	Slamgeesh	0%	0%	100%
	Spawning	0%	0%	100%
	Stephens	0%	0%	100%
	Sustut	0%	0%	100%
	Swan/Club	0%	0%	100%
	Tahlo/Morrison	12%	88%	0%
Sockeye (river-type)	Skeena River	48%	26%	26%
	Skeena River-High Interior	0%	17%	83%

Nass Region

Table A. 30. The percentage of watersheds within each CU's spawning zone of influence that are rated high, moderate, or low risk (i.e. red, amber, green) for cumulative habitat pressures.

Nass Region				
Species	**Conservation Unit**	**High Risk**	**Moderate Risk**	**Low Risk**
Chinook	Portland Sound-Observatory Inlet-Lower Nass	10%	50%	40%
	Upper Nass	39%	37%	24%
Chum	Lower Nass	30%	54%	15%
	Portland Canal-Observatory	3%	42%	55%
	Portland Inlet	0%	35%	65%
Coho	Lower Nass	27%	56%	17%
	Portland Sound-Observatory Inlet-Portland Canal	2%	47%	51%
	Upper Nass	36%	43%	21%
Pink (even-year)	Upper Nass	48%	52%	0%
Pink (odd-year)	Nass-Portland-Observatory	11%	47%	42%
	Upper Nass	48%	52%	0%
Sockeye (lake-type)	Bowser	6%	51%	43%
	Clements	0%	100%	0%
	Damdochax	0%	0%	100%
	Fred Wright	0%	100%	0%
	Kwinageese	0%	100%	0%
	Leverson	0%	0%	100%
	Meziadin	35%	33%	32%

Nass Region				
Species	**Conservation Unit**	**High Risk**	**Moderate Risk**	**Low Risk**
Sockeye (river-type)	Oweegee	100%	0%	0%
	Lower Nass-Portland	51%	49%	0%
	Upper Nass River	62%	16%	22%

Central Coast Region

Table A. 31. The percentage of watersheds within each CU's spawning zone of influence that are rated high, moderate, or low risk (i.e. red, amber, green) for cumulative habitat pressures.

Central Coast Region				
Species	**Conservation Unit**	**High Risk**	**Moderate Risk**	**Low Risk**
Chinook	Bella Coola-Bentinck	39%	24%	36%
	Dean River	7%	44%	48%
	Docee	38%	49%	13%
	North & Central Coast-Early	13%	28%	59%
	North & Central Coast-Late	0%	10%	90%
	Rivers Inlet	5%	45%	50%
	Wannock	0%	45%	55%
Chum	Bella Coola River-Late	100%	0%	0%
	Bella Coola-Dean Rivers	34%	42%	24%
	Douglas-Gardner	12%	36%	53%
	Hecate Lowlands	1%	11%	88%

Central Coast Region				
Species	**Conservation Unit**	**High Risk**	**Moderate Risk**	**Low Risk**
	Mussel-Kynoch	0%	0%	100%
	Rivers Inlet	6%	73%	21%
	Smith Inlet	19%	35%	45%
	Spiller-Fitz-Hugh-Burke	18%	17%	65%
	Wannock	0%	45%	55%
Coho	Bella Coola-Dean Rivers	50%	40%	10%
	Brim-Wahoo	0%	0%	100%
	Douglas Channel-Kitimat Arm	28%	34%	39%
	Hecate Strait Mainland	5%	17%	78%
	Mussel-Kynoch	0%	13%	87%
	Northern Coastal Streams	8%	25%	68%
	Rivers Inlet	5%	56%	39%
	Smith Inlet	32%	33%	35%
Pink (even-year)	Hecate Lowlands	4%	17%	79%
	Hecate Strait-Fjords	15%	38%	47%
Pink (odd-year)	Hecate Strait-Fjords	13%	31%	57%
	Hecate Strait-Lowlands	5%	16%	78%
	Homathko-Klinaklini-Smith-Rivers-Bella Coola-Dean	7%	72%	22%
Sockeye (lake-type)	Backland	0%	29%	71%
	Banks	0%	0%	100%
	Bloomfield	0%	0%	100%

Central Coast Region				
Species	**Conservation Unit**	**High Risk**	**Moderate Risk**	**Low Risk**
	Bolton Creek	0%	0%	100%
	Bonilla	0%	0%	100%
	Borrowman Creek	0%	0%	100%
	Busey Creek	0%	0%	100%
	Canoona	0%	0%	100%
	Cartwright Creek	0%	0%	100%
	Chic Chic	0%	0%	100%
	Citeyats	0%	0%	100%
	Curtis Inlet	0%	0%	100%
	Dallain Creek	0%	0%	100%
	Deer	0%	0%	100%
	Devon	0%	0%	100%
	Dome	0%	0%	100%
	Douglas Creek	0%	0%	100%
	Elizabeth	0%	0%	100%
	Elsie/Hoy	0%	100%	0%
	End Hill Creek	0%	0%	100%
	Evelyn	0%	100%	0%
	Evinrude Inlet	0%	0%	100%
	Fannie Cove	0%	0%	100%
	Freeda	0%	0%	100%

Central Coast Region				
Species	**Conservation Unit**	**High Risk**	**Moderate Risk**	**Low Risk**
	Hartley Bay	0%	100%	0%
	Hevenor Inlet	0%	0%	100%
	Higgins Lagoon	0%	0%	100%
	Kadjusdis River	0%	0%	100%
	Kainet Creek	0%	0%	100%
	Kdelmashan Creek	0%	0%	100%
	Keecha	0%	0%	100%
	Kent Inlet Lagoon Creek	0%	0%	100%
	Kenzuwash Creeks	0%	0%	100%
	Keswar Creek	0%	0%	100%
	Kildidt Creek	0%	0%	100%
	Kildidt Lagoon Creek	0%	0%	100%
	Kimsquit	0%	0%	100%
	Kisameet	0%	0%	100%
	Kitkiata	0%	100%	0%
	Kitlope	0%	0%	100%
	Koeye	0%	12%	88%
	Kooryet	0%	0%	100%
	Kunsoot River	100%	0%	0%
	Kwakwa Creek	0%	0%	100%
	Lewis Creek	0%	0%	100%

Central Coast Region				
Species	**Conservation Unit**	**High Risk**	**Moderate Risk**	**Low Risk**
	Limestone Creek	0%	0%	100%
	Long	0%	28%	72%
	Lowe/Simpson/Weir	0%	0%	100%
	Mary Cove Creek	0%	100%	0%
	Mcdonald Creek	0%	0%	100%
	Mcloughlin	100%	0%	0%
	Mikado	0%	0%	100%
	Monckton Inlet Creek	0%	0%	100%
	Namu	0%	0%	100%
	Owikeno	5%	16%	80%
	Pine River	0%	0%	100%
	Port John	0%	0%	100%
	Powles Creek	0%	0%	100%
	Price Creek	0%	0%	100%
	Roderick	0%	0%	100%
	Ryan Creek	0%	0%	100%
	Salter	0%	0%	100%
	Scoular/Kilpatrick	0%	0%	100%
	Sheneeza Inlet	0%	0%	100%
	Ship Point Creek	0%	0%	100%
	Soda Creek	0%	0%	100%

Central Coast Region				
Species	**Conservation Unit**	**High Risk**	**Moderate Risk**	**Low Risk**
	South Atnarko Lakes	16%	18%	66%
	Spencer Creek	0%	0%	100%
	Stannard Creek	0%	0%	100%
	Talamoosa Creek	0%	0%	100%
	Tankeeah River	0%	0%	100%
	Treneman Creek	0%	0%	100%
	Tsimtack/Moore/Roger	0%	0%	100%
	Tuno Creek East	0%	0%	100%
	Tuno Creek West	0%	0%	100%
	Tyler Creek	0%	0%	100%
	Wale Creek	0%	0%	100%
	Wannock (Owikeno)	5%	16%	80%
	Watt Bay	0%	0%	100%
	West Creek	0%	0%	100%
	Yaaklele Lagoon	0%	0%	100%
	Yeo	100%	0%	0%
Sockeye (river-type)	Northern Coastal Fjords	18%	22%	60%
	Northern Coastal Streams	2%	30%	68%
	Rivers-Smith Inlets	0%	77%	23%

Fraser Region

Table A. 32. The percentage of watersheds within each CU's spawning zone of influence that are rated high, moderate, or low risk (i.e. red, amber, green) for cumulative habitat pressures.

Fraser Region				
Species	**Conservation Unit**	**High Risk**	**Moderate Risk**	**Low Risk**
Chinook	Boundary Bay (Fall 4_1)	100%	0%	0%
	Fraser Canyon-Nahatlatch (Spring 5_2)	25%	34%	41%
	Lower Fraser River (Fall 4_1)	100%	0%	0%
	Lower Fraser River (Spring 5_2)	23%	77%	0%
	Lower Fraser River (Summer 5_2)	31%	36%	33%
	Lower Fraser River-Maria Slough (Summer 4_1)	100%	0%	0%
	Lower Fraser River-Upper Pitt (Summer 5_2)	66%	19%	14%
	Lower Thompson River (Spring 4_2)	69%	27%	4%
	Middle Fraser River (Spring 5_2)	57%	32%	11%
	Middle Fraser River (Summer 5_2)	56%	26%	18%
	Middle Fraser River-Portage (Fall 5_2)	90%	0%	10%
	North Thompson River (Spring 5_2)	83%	17%	0%
	North Thompson River (Summer 5_2)	73%	15%	11%
	Shuswap River (Summer 4_1)	62%	38%	0%
	South Thompson River (Summer 4_1)	59%	27%	14%
	South Thompson River (Summer 5_2)	67%	29%	3%

Fraser Region				
Species	**Conservation Unit**	**High Risk**	**Moderate Risk**	**Low Risk**
	South Thompson River-Bessette Creek (Summer 4_2)	100%	0%	0%
	South Thompson-Adams River Upper	46%	54%	0%
	Upper Fraser River (Spring 5_2)	25%	44%	30%
Chum	Lower Fraser	67%	21%	12%
Coho	Boundary Bay	100%	0%	0%
	Fraser Canyon	61%	17%	23%
	Interior Fraser	41%	28%	32%
	Lillooet	22%	49%	28%
	Lower Fraser	73%	18%	8%
	Lower Thompson	65%	28%	8%
	North Thompson	66%	26%	8%
	South Thompson	50%	37%	14%
Pink (odd-year)	Fraser River	59%	29%	11%
Sockeye (lake-type)	Adams & Momich Lakes-Early Summer	35%	36%	29%
	Adams-Early Summer	39%	29%	32%
	Alouette-Early Summer	60%	0%	40%
	Anderson-Seton-Early Summer	24%	24%	52%
	Bowron-Early Summer	0%	41%	59%
	Chilko-Early Summer	0%	0%	100%
	Chilko-Summer	0%	18%	82%

Fraser Region				
Species	**Conservation Unit**	**High Risk**	**Moderate Risk**	**Low Risk**
	Chilliwack-Early Summer (cyclic)	21%	67%	12%
	Coquitlam-Early Summer	30%	0%	70%
	Cultus-Late	82%	18%	0%
	Francois-Fraser-Summer	62%	32%	6%
	Fraser-Early Summer	63%	32%	6%
	Harrison-Downstream Migrating-Late	16%	31%	53%
	Harrison-Upstream Migrating-Late	100%	0%	0%
	Kamloops-Early Summer	46%	27%	27%
	Kawkawa-Late	100%	0%	0%
	Lillooet-Harrison-Late	13%	33%	54%
	Momich-Early Summer	17%	72%	11%
	Nadina-Francois-Early Summer	62%	32%	6%
	Nahatlatch-Early Summer	5%	20%	75%
	North Barriere-Early Summer	69%	28%	2%
	North Barriere-Early Summer (de novo)	69%	28%	2%
	Pitt-Early Summer	10%	34%	56%
	Quesnel-Summer (cyclic)	33%	24%	43%
	Seton-Late (de novo)	24%	24%	52%
	Seton-Summer	24%	24%	52%
	Shuswap-Early Summer (cyclic)	45%	28%	27%

Fraser Region				
Species	**Conservation Unit**	**High Risk**	**Moderate Risk**	**Low Risk**
	Shuswap-Late (cyclic)	45%	28%	27%
	Takla-Trembleur-Early Stuart (cyclic)	21%	41%	38%
	Takla-Trembleur-Stuart-Summer (cyclic)	30%	39%	30%
	Taseko-Early Summer	3%	35%	62%
Sockeye (river-type)	Harrison River	100%	0%	0%
	Widgeon	0%	100%	0%

Vancouver Island and Mainland Inlets Region

Table A. 33. The percentage of watersheds within each CU's spawning zone of influence that are rated high, moderate, or low risk (i.e. red, amber, green) for cumulative habitat pressures.

Vancouver Island and Mainland Inlets Region				
Species	**Conservation Unit**	**High Risk**	**Moderate Risk**	**Low Risk**
Chinook	East Vancouver Island-Cowichan and Koksilah (Fall X_1)	74%	21%	5%
	East Vancouver Island-Georgia Strait (Summer 4_1)	72%	24%	4%
	East Vancouver Island-Goldstream (Fall X_1)	100%	0%	0%
	East Vancouver Island-Nanaimo (Spring X_2)	0%	100%	0%
	East Vancouver Island-Nanaimo and Chemainus (Fall X_1)	68%	32%	0%
	East Vancouver Island-North (Fall X_1)	63%	30%	8%

Vancouver Island and Mainland Inlets Region				
Species	**Conservation Unit**	**High Risk**	**Moderate Risk**	**Low Risk**
	East Vancouver Island-Qualicum and Puntledge (Fall X_1)	71%	29%	0%
	Homathko (Summer X_x)	0%	49%	51%
	Klinaklini (Summer 5_2)	3%	29%	68%
	Southern Mainland-Georgia Strait (Fall X_1)	26%	27%	48%
	Southern Mainland-Southern Fjords (Fall X_1)	6%	56%	37%
	West Vancouver Island-Nootka and Kyuquot (Fall X_1)	55%	31%	14%
	West Vancouver Island-North (Fall X_1)	58%	42%	0%
	West Vancouver Island-South (Fall X_1)	40%	41%	20%
Chum	Bute Inlet	0%	53%	47%
	Georgia Strait	70%	20%	10%
	Howe Sound-Burrard Inlet	56%	35%	10%
	Loughborough	50%	38%	13%
	Northeast Vancouver Island	46%	43%	11%
	Northwest Vancouver Island	64%	30%	6%
	Southern Coastal Streams	22%	57%	22%
	Southwest & West Vancouver Island	52%	30%	19%
	Upper Knight	0%	22%	78%
Coho	Clayoquot	32%	21%	48%
	East Vancouver Island-Georgia Strait	64%	29%	7%

Vancouver Island and Mainland Inlets Region				
Species	**Conservation Unit**	**High Risk**	**Moderate Risk**	**Low Risk**
	East Vancouver Island-Johnstone Strait-Southern Fjords	43%	49%	8%
	Georgia Strait Mainland	45%	24%	30%
	Homathko-Klinaklini Rivers	0%	28%	72%
	Howe Sound-Burrard Inlet	58%	32%	10%
	Juan de Fuca-Pachena	44%	50%	6%
	Nahwitti Lowland	50%	40%	10%
	Southern Coastal Streams-Queen Charlotte Strait-Johnstone Strait-Southern Fjords	28%	43%	29%
	West Vancouver Island	52%	34%	14%
Pink (even-year)	Georgia Strait	51%	33%	16%
	Northwest Vancouver Island	60%	35%	4%
	Southern Fjords	32%	47%	22%
	West Vancouver Island	65%	29%	6%
Pink (odd-year)	East Howe Sound-Burrard Inlet	57%	43%	0%
	East Vancouver Island-Johnstone Strait	69%	25%	6%
	Georgia Strait	50%	30%	20%
	Nahwitti	45%	47%	8%
	Southern Fjords	30%	38%	32%
	West Vancouver Island	65%	29%	6%
Sockeye (lake-type)	Alice	52%	33%	15%
	Canoe Creek	0%	0%	100%

Vancouver Island and Mainland Inlets Region				
Species	**Conservation Unit**	**High Risk**	**Moderate Risk**	**Low Risk**
	Cecilia	0%	0%	100%
	Cheewat	0%	100%	0%
	Clayoquot	0%	0%	100%
	Deserted	100%	0%	0%
	Fairy	23%	74%	3%
	Fulmore	100%	0%	0%
	Great Central	28%	47%	25%
	Henderson	34%	66%	0%
	Hesquiat	0%	59%	41%
	Heydon	0%	100%	0%
	Hobiton	0%	0%	100%
	Ida-Bonanza	46%	54%	0%
	Jansen	100%	0%	0%
	Kakweiken	0%	18%	82%
	Kanim	100%	0%	0%
	Kennedy	36%	38%	26%
	Loose	100%	0%	0%
	Mackenzie	0%	100%	0%
	Maggie	51%	49%	0%
	Megin	0%	0%	100%
	Muchalat	32%	56%	12%

Vancouver Island and Mainland Inlets Region				
Species	**Conservation Unit**	**High Risk**	**Moderate Risk**	**Low Risk**
	Muriel	100%	0%	0%
	Nahwitti	31%	57%	13%
	Nimpkish	14%	71%	15%
	Nitinat	34%	55%	11%
	O'Connell	100%	0%	0%
	Park River	100%	0%	0%
	Phillips	0%	35%	65%
	Power	0%	0%	100%
	Quatse	75%	25%	0%
	Sakinaw	0%	100%	0%
	Schoen	0%	33%	67%
	Shushartie	0%	100%	0%
	Sproat	43%	45%	12%
	Tzoonie	0%	100%	0%
	Vernon	0%	100%	0%
	William-Brink	0%	100%	0%
	Woss	0%	46%	54%
Sockeye (river-type)	East Vancouver Island & Georgia Strait	43%	46%	11%
	NW Vancouver Island	58%	31%	11%
	Southern Fjords	38%	39%	23%
	West Vancouver Island	45%	35%	20%

Haida Gwaii Region

Table A. 34. The percentage of watersheds within each CU's spawning zone of influence that are rated high, moderate, or low risk (i.e. red, amber, green) for cumulative habitat pressures.

Haida Gwaii				
Species	**Conservation Unit**	**High Risk**	**Moderate Risk**	**Low Risk**
Chinook	North Haida Gwaii	82%	12%	6%
	East Haida Gwaii	40%	40%	20%
Chum	North Haida Gwaii – Stanley Creek	0%	100%	0%
	East Haida Gwaii	39%	29%	32%
	North Haida Gwaii	86%	7%	7%
	West Haida Gwaii	5%	30%	65%
	Skidegate	46%	23%	31%
Coho	East Haida Gwaii	43%	30%	27%
	West Haida Gwaii	5%	34%	61%
	Graham Island Lowlands	56%	17%	27%
Pink (even-year)	North Haida Gwaii	72%	16%	12%
	East Haida Gwaii	41%	30%	30%
	West Haida Gwaii	5%	37%	58%
Pink (odd-year)	East Haida Gwaii	38%	32%	30%
	North Haida Gwaii	75%	12.5%	12.5%
	West Haida Gwaii	6%	41%	53%
Sockeye (lake-type)	Ain/Skundale/Ian	16.5%	67%	16.5%
	Awun	100%	0%	0%

Haida Gwaii				
Species	**Conservation Unit**	**High Risk**	**Moderate Risk**	**Low Risk**
	Fairfax	0%	100%	0%
	Jalun	0%	0%	100%
	Marian/Eden	100%	0%	0%
	Mathers	0%	100%	0%
	Mercer	0%	0%	100%
	Skidegate	100%	0%	0%
	Yakoun	83%	0%	17%
	Marie	100%	0%	0%
Sockeye (river-type)	East Haida Gwaii	38%	31%	31%
	North Haida Gwaii	67%	33%	0%
	West Haida Gwaii	9%	43%	48%

Columbia Region

Table A. 35. The percentage of watersheds within each CU's spawning zone of influence that are rated high, moderate, or low risk (i.e. red, amber, green) for cumulative habitat pressures.

Columbia				
Species	**Conservation Unit**	**High Risk**	**Moderate Risk**	**Low Risk**
Chinook	Okanagan	100%	0%	0%
Chum	Not applicable, no CUs identified.	NA	NA	NA
Coho	Not applicable, no CUs identified.	NA	NA	NA
Pink (even-year)	Not applicable, no CUs identified.	NA	NA	NA
Pink (odd-year)	Not applicable, no CUs identified.	NA	NA	NA
Sockeye (lake-type)	Osoyoos	95%	5%	0%
Sockeye (river-type)	Not applicable, no CUs identified.	NA	NA	NA